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ANALYSIS OF AIRCRAFT EXHAUST EMISSION MEASUREMENTS: STATISTICS

By: H.T. McAdams

CAL No. NA-5007-K-2

Prepared For:

ENVIRONMENTAL PROTECTION AGENCY
DIVISION OF EMISSION CONTROL TECHNOLOGY
CHARACTERIZATION & CONTROL DEVELOPMENT BRANCH
ANN ARBOR, MICHIGAN 48103

Contract No. 68-04-0040
19 November 1971

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16. Abstracts

Descriptive accounts are presented of statistical procedures which were applied to the analysis of mass emissions data as determined from aircraft exhaust emissions measurements. Results of these analyses are discussed, with an emphasis on the significance of the results within the context of the data base available. In essence, the purpose of the report is to isolate the causes or sources of both fixed and random contributions to the variability observed in the data and to estimate, wherever possible, the magnitudes of these contributions. Specific questions of broad interest are addressed and statistical inferences drawn with respect to these questions. In recognition of the restricted scope of the Phase II effort, however, a primary function of the report is to provide a statistically based methodology and general guidelines by which the reader can perform additional analyses of the large mass of data available as required by his own unique interests.

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FOREWORD

This report was prepared by Cornell Aeronautical Laboratory, Inc. (CAL), Buffalo, New York under Environmental Protection Agency (EPA) Contract No. 68-04-0040. The work was administered under the direction of the Office of Air Programs, Characterization & Control Development Branch, Division of Emission Control Technology, Mr. Barry D. McNutt, Project Officer.

This is the Phase II Technical Report that discusses the results of statistical studies applied to the numerical data for aircraft exhaust emissions previously published as the Phase I project report. The studies reported herein were conducted during October and November 1971.

The effort was performed by the Systems Research Department of CAL. Inasmuch as the sole source of the data utilized in this study is represented by the Phase I report, it is fitting to acknowledge the contributions of those individuals responsible for that report and whose names appear in the Foreword thereto. Especially to be acknowledged in connection with the Phase II effort is the capable assistance of Mr. Gary Higgins, who was primarily responsible for the computer processing essential to this report.

ABSTRACT

Descriptive accounts are presented of statistical procedures which were applied to the analysis of mass emissions data as determined from aircraft exhaust emissions measurements. Results of these analyses are discussed, with an emphasis on the significance of the results within the context of the data base available. In essence, the purpose of the report is to isolate the causes or sources of both fixed and random contributions to the variability observed in the data and to estimate, wherever possible, the magnitudes of these contributions. Specific questions of broad interest are addressed and statistical inferences drawn with respect to these questions. In recognition of the restricted scope of the Phase II effort, however, a primary function of the report is to provide a statistically based methodology and general guidelines by which the reader can perform additional analyses of the large mass of data available as required by his own unique interests.

1. INTRODUCTION

An extensive compilation of aircraft exhaust emissions data has been previously published (October 15, 1971) by Cornell Aeronautical Laboratory, Inc. (CAL) as CAL No. NA-5007-K-1, Analysis of Aircraft Exhaust Emissions Measurements, by L. Bogdan and H. T. McAdams. The experimental data making up that report consisted of concentration measurements of the exhaust gases generated by turboprop and thrust turbine aircraft engines, light-utility piston aircraft engines and auxiliary power units. These concentration data were processed, wherever such processing was possible and applicable to the promulgation of emission standards, in such a way as to estimate mass emissions over specified landing-takeoff (LTO) cycles. The experimental data and the LTO cycle specifications were provided by the Office of Air Programs, Environmental Protection Agency (EPA), for whom the analysis was undertaken. In order to coordinate and reduce to a standard and consistent basis the several sources of emissions data, it was often necessary to employ graphical techniques, interpolation, and sometimes extrapolation. Results obtained by these techniques, as well as the original data serving as input, were published in the aforementioned document, which will subsequently be referred to herein as the Phase I Report.

Results contained in the referenced Phase I Report embrace approximately 400 aircraft engines and cover a diversity of engine models and the factors which might influence their measured emissions. Eight different test teams, operating in ten different geographic locations, were involved. Accordingly, a spectrum of ambient conditions is represented in the data available, this spectrum reflecting differences in temperature, humidity and atmospheric pressure. At some of the test facilities only new engines were tested, whereas at others only used engines undergoing maintenance were available. In some instances, engines tested were equipped with smokeless burner cans, in distinction to the regular burner cans in normal use. The compiled data, considered in the aggregate, forms a baseline for the setting of aircraft emission standards.

In view of the diversity of the tests performed under the program and the extent of the data available, it is natural to ask if this baseline information might not provide additional insights concerning the factors which affect exhaust emissions. In particular, the following questions are of interest to EPA, to the aircraft industry, and to a broad scientific community concerned with air pollution:

1. How much variability in exhaust emissions exists from one engine to another of the same model? How repeatable are measurements on a particular engine? To what extent is lack of repeatability due to instrumental errors and to other aspects of the testing operation?
2. How many tests are required on a particular engine in order to have "reasonable" confidence that its emissions are known to within a specified interval of values? How many engines of a particular model must be tested in order to have similar confidence for the model? What is the optimum tradeoff between many repeat (replicate) tests on a few engines and few replicate tests on many engines?
3. What is the effect of engine age, as measured by - say - time since last overhaul of the hot section, on exhaust emissions?
4. To what extent do ambient environmental conditions affect emissions -- e.g., does specific humidity affect NOX emissions? Do differences between test site locations induce differences in engine exhaust emissions?
5. Do smokeless retrofits affect gaseous emissions from aircraft engines?

The order in which the questions above are listed is not to be construed as their order of importance. It is the purpose of this report to essay answers to these questions to the extent feasible within the limitations of the data base. Though many other questions relevant to aircraft emissions can be framed in the context of the available data, attention will be directed primarily to the concerns noted above.

2. A STATISTICAL VIEW OF TEST DATA

Errors affecting test data can be classified as either systematic or random in nature. Systematic errors are those which derive from some influence which tends to bias results in a particular way; for example, if an instrument is miscalibrated, all results obtained from that instrument may tend to be too high or too low, depending on the direction of the bias. Random errors, on the other hand, are those which are induced by random causes and, for the most part, are as likely to be positive as negative relative to the true result. Their occurrence is less readily annotated than in the case of systematic errors; in fact, they are often alluded to as "unassignable causes" to emphasize the fact that on any particular observation a cause-effect relation holds, but knowledge of this relationship is not available to the observer. By virtue of the fact that such causes are presumed to operate in a random fashion, their effects on test data are amenable to statistical assessment and control and can be assayed in these terms.

In an examination of the available aircraft emission data, the distinction between systematic and random errors must be made with care. The distinction is often a subtle one, and it is for this reason that some discourse on the subject is considered to be in order. Accordingly, the notion of a statistical model will be introduced and developed in relation to the aircraft emissions data.

2.1 Random Variables and Induced Errors

A random variable is a function defined on a sample space. For example, a pair of dice can exist in a number of "states," in which any integer from 1 to 6 can occur on either of the dice. There are thus 36 possibilities in the sample space, each of which is presumed to have equal likelihood of occurring. A familiar function (though not the only possible one) is the sum of the two numbers which appear when the dice are thrown. These sums are integers between 2 and 12; each will occur with a particular frequency controlled by the "equal likelihood" process applicable to the individual dies and by the combinatorial rules which make it possible to obtain the same sum by several routes -- e.g., 5 = 1 + 4, 5 = 2 + 3, etc. The sums, therefore, constitute a random variable induced by the "random causes" underlying the throwing of the dice. In a similar way, certain random occurrences can induce random contributions to aircraft emissions measurements, though the physical processes involved may be infinitely more complicated than the throwing of dice.

The labored analogy above is presented not for its usual pedagogical reasons but to emphasize the fact that one random process begets another and that to understand error distributions it is instructive to consider their origins. Under certain conditions, it is possible to decompose the observed errors into "components" associated with specific cause systems; under other circumstances, the several sources may be hopelessly intertwined or "confounded" in such a way that decomposition is impossible or impractical. It is a major concern of good experiment design to plan tests in such a way that the sources of variability of interest to the experimenter can be unambiguously isolated and quantified. Expediency, cost and other compelling considerations often prevent such an optimum experiment, however, and the aircraft emissions program is no exception. It is the intent of this report to structure error contributions wherever possible and, where such analysis is not possible, to point out the nature of the confounding and to recommend experiments which might correct these shortcomings.

2.2 Variance-Component Statistical Models: A Prolegomenon

Consider the dice-throwing experiment discussed in the previous section. Simple heuristic analysis will show that the "average" result obtained from the throwing of a single die is (1 + 2 + 3 + 4 + 5 + 6)/6 = 3.5. By slightly more argument it can be shown that the average sum for the two dice is 7. Individual outcomes for particular throws of the dice will therefore tend to cluster about 7 and could, for purposes of analysis, be referred to this mean value and expressed as deviations or excursions from the mean value. Furthermore, these excursions could be decomposed into separate contributions for each of the two dies. Though the two contributions would be expected to be equal for "honest" dice, such would not be the case if one of the dies were "loaded". In this case two different systems of random causes would be at work, and each would induce its own contribution to the distribution of excursions from the mean value. If the two dies were tagged and their separate values noted, then their separate contributions to "error" could be deduced. On the other hand, if only their combined sum were reported, their individual contributions would be confounded and would not be accessible by analysis.

The simple dice experiment gives rise to the following statistical model:

$$y_{ij} = \mu + \alpha_i + \beta_j \tag{1}$$

where μ is the mean outcome of the experiment, α_i is the contribution of the i^{th} state of the first die and β_j is the contribution of the j^{th} state of the second die. The model is of particular interest to the exhaust-emissions analysis because, with minor modification, it is applicable to the contributions to variability made by engine-to-engine variation and by sources of error associated with the emissions-measurement process. By a process of analysis of variance, the variance associated with y, the sum of the two dice, can be decomposed as

$$\sigma^2 = \sigma_\alpha^2 + \sigma_\beta^2$$

where σ_α^2 is the variance contributed by the first die and σ_β^2 is the variance contributed by the second die. Note that if one of the dies is heavily weighted, its contribution to the variance of y may be nearly or entirely negligible. Instead, its contribution will be felt as a "bias" in the mean value of y, and the previously mentioned subtlety of the distinction between systematic and random errors becomes apparent.

The simple statistical model presented above is essentially that which applies to test data in which replicate tests are made on a number of engines of a particular model. If the results of all the tests are averaged, one obtains a mean value about which all the observations tend to cluster. Consider now, however, the average of all repeat measurements made for a particular engine. The extent to which this average departs from the "grand average" of all the tests can be considered as a contribution peculiar to that engine and plays the role of α_i in the model. Similarly, one can regard the excursions of the individual repeat measurements from the average for a particular engine as a contribution peculiar to the particular test run involved; these excursions play the role of β_j in the model. Thus the result for the j^th test on the i^th engine can be modeled as

$$y_{ij} = \mu + \alpha_i + \beta_j(i) \qquad (2)$$

and variances σ_α^2 and σ_β^2 can be extracted, under favorable conditions, to serve as measures of the contributions made by engine differences and test-run differences respectively. The difference between Equation (1) and Equation (2) resides in the term $\beta_j(i)$. In (2), the notation $\beta_j(i)$ implies that the run-to-run variability occurs within a particular engine and has no meaning in relation to a different engine. Since any given engine can be repeat tested to any extent desired, the contributions in (2) can assume different weights if all measurements are simply "pooled" into a "model summary", as was done in the Phase I Report. To appreciate this point, consider a compilation in which 12 tests were averaged and their standard deviation computed. Suppose that in one case only two different engines were available, but that each was tested 6 times. In a certain sense, more opportunity for test-to-test variability is allowed than for engine-to-engine variability. On the other hand, suppose that six engines were available and that each was tested twice. Now the reverse is true. Depending on which of the two contributions is the larger, the pooled variance may be too high or two low to represent the simple sum of the two contributions, as would be obtained if 12 engines were available and each were tested once. Though the latter arrangement would provide an unbiased estimate of the combined variance, the individual contributions would be confounded and it would not be possible to decompose this variance into its components. Fortunately for our purposes, a considerable amount of data in the Phase I Report is so structured that it permits such decomposition, and simple analysis-of-variance (ANOVA) procedures makes it possible to "unscramble" the weighting induced by different combinations of number of engines tested and number of repeat runs on each. The specific techniques employed for this purpose will become apparent in later sections of the report devoted to the analysis of the Phase I data.

As will be evident in subsequent discussion of the aircraft emission data, the simple model of Equation (2) can be expanded to encompass many other sources of variance. Presumably, ambient environmental conditions such as temperature, humidity and atmospheric pressure, would make contributions to the variability observed in test results. Differences in type of fuel might be expected to have an influence on emissions, as might also age and condition of the engine. Contributions arising from such sources can be represented as additional terms in the model of Equation (2). In some cases these contributions might be of a random nature; in others, they might constitute "fixed effects", that is, contributions uniquely associated with a particular value of the perturbing variable. For example, if two fuels are involved, each might be expected to have a unique effect on emissions, and, in this case, the concept of random causes would not be applicable. Nevertheless, a decomposition of the type represented by Equation (2) would still be applicable; only its interpretation would be altered.

2.3 Confidence Intervals: Their Use and Misuse

One of the most persistent questions in statistical inference is the question: How much data is enough? Its answer in statistical terms is seldom satisfying and, this being the case, much more is often read into the answer than is permissible by strict statistical rigor. A convenient repository for such interpretational liberties is the concept of "confidence interval", and it is to this concept that our present concern is directed.

Let us imagine that an "infinite" supply of aircraft engines of a particular model - say JT8D - is available. Suppose that N of these engines are selected at random and that each is tested once for its mass emissions. From the N tests, the mean or average value can be computed, as can also the standard deviation of the individual measurements about this mean. One must note, however, that the N engines measured are only a "sample" of the entire population of engines and that a second set of N engines will not necessarily yield the same sample mean or sample standard deviation. Moreover, neither of the sample means are likely to coincide with the population mean, which could be determined by measuring emissions for "all" engines in the population. Similarly, the sample standard deviations would be unlikely to coincide with the "true" or population standard deviation similarly obtained by exhaustively measuring all engines in the population. The concept of "confidence interval" represents an attempt to invest a sample result with some measure of "nearness" to the population result. For large value of N, for example, it can be shown that the sample mean will tend to be "closer" to the population mean than would be the case for small values of N. By the reverse of this reasoning process, one can postulate how large N should be in order to achieve a certain degree of "nearness" to the true or population mean. It is evident, however, that the question of "How many tests are needed?" must be preceded by a question which asks, in essence, "How close to the truth is close enough?"

The mechanics of computing a confidence interval is straightforward. For example, suppose that 10 engines are tested and that for each engine the total CO mass for the prescribed LTO cycle is calculated.

Call the CO mass measurements for the 10 engines x_1, x_2,...,x_{10}. Their mean is

$$\bar{x} = 1/10\,(x_1 + x_2 + \ldots + x_{10})$$

and their sample standard deviation* is

$$s = \sqrt{\frac{\sum_{i=1}^{10} (x_i - \bar{x})^2}{10}}$$

---

* The sample variance, defined as $s^2 = 1/N \sum_{i=1}^{N} (x_i - \bar{x})^2$ does not provide an unbiased estimate of σ^2, the population standard deviation. The bias is eliminated by using N-1 in place of N. This practice was followed in the Phase I report.

As a random variable, $\bar{x}$ is an unbiased estimator of μ, the population mean. Similarly,

$$\hat{\sigma}^2 = \frac{\sum_{i=1}^{N} (x_i - \bar{x})^2}{N - 1}$$

is an unbiased estimator of the population variance.

Inasmuch as $\bar{x}$ is a random variable, it has its own variance; the magnitude of this variance is inversely proportional to N, the sample size. Thus an unbiased estimator for the variance of $\bar{x}$ is

$$\hat{\sigma}^2/N = \frac{\sum_{i=1} (x_i - \bar{x})^2}{N(N-1)}$$

and the square root of this quantity is the standard error of the sample mean. By making certain assumptions regarding the statistical distribution of $\bar{x}$, one can compute the required confidence interval.

Confidence intervals rely on the assumption that the sample mean, as a random variable, obeys a normal or Gaussian distribution with some population mean μ and variance σ^2/N, where σ^2 is the population variance of X and N is the sample size.* If repeated samples are taken from the population, and if σ^2 is known, approximately 68% of the resulting values of $\bar{x}$ will fall within an interval bounded on the low side by $\mu - \sigma$ and on the high side by $\mu + \sigma$. Similarly, approximately 95% of the values of $\bar{x}$ will lie in the interval $\mu - 2\sigma$ to $\mu + 2\sigma$, and other percentages of the cases can be bracketed by appropriate choice of k in the quantities $\mu - k\sigma$ and $\mu + k\sigma$ which bound the interval. Suppose, however, that only the result from a particular sample is available. The sample quantities $\bar{x}$ and $\hat{\sigma}$ provide estimates of μ and σ, and it is presumed that these values can be used to construct a confidence interval

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* If N is only moderately large, the validity of this assumption is assured by the Central Limit Theorem of mathematical statistics. In statistical quality control, for example, it is found that N may be as small as 4 or 5.

$$\bar{x} - k\hat{\sigma} \leq \mu \leq \bar{x} + k\hat{\sigma}$$

and that by proper choice of k, the width of the interval can be adjusted to - say - 95% confidence that the population mean μ will be contained in the interval. For example, if $\bar{x}$ = 30.25 pounds CO per LTO cycle and $\hat{\sigma}$ = 6.21 pounds, a 95% confidence interval for μ is provided by

$$30.25 - k(6.21/\sqrt{N}) \leq \mu \leq 30.25 + k(6.21/\sqrt{N})$$

For large N, the value of k approaches 1.96, but for small values of N, the value may be considerably larger. For example, if N = 10, k = 2.26, and the interval becomes

$$25.81 \leq \mu \leq 34.69 \tag{3}$$

A word of caution is in order, however. The population mean is a constant, not a random variable. In reality, therefore, μ either is or is not contained in the interval given by (3). It is the interval, as computed from the sample data, which statistically varies; both its midpoint and its width depends on the particular values obtained in the sample. If repeated samples of 10 engines were tested and a confidence interval computed for each of these samples, approximately 95% of the intervals so constructed would contain the population mean μ . It is in this sense that the confidence interval should be interpreted. Thus, in the above example, if one asserts that μ falls in the interval 25.81 to 34.69, such an assertion is "more likely" to be true than false; in the sense indicated, the assertion has probability 0.95 of being a true statement.

Properly interpreted, the concept of confidence interval is a useful one in answering the question of "How many observations are needed to establish the mean value of a random variable to within certain prescribed limits and to a certain level of confidence?" In the following section of this report, this question will be addressed to the emissions data published in the Phase I report. The mean mass emissions given there, and the corresponding standard deviations, will be employed in estimating confidence intervals as a function of number of tests conducted.

3. STATISTICAL SIGNIFICANCE OF EMISSIONS DATA

Basic information pertinent to statistical assessment of the aircraft emission data of the Phase I report is provided by the model summaries of that document, a typical example of which is given in Table 1. In this summary, T56-A7 turboprop engines, 11 in number, were tested by Southwest Research Institute at Kelly Air Force Base. For each engine, pollutant concentrations were available at various power settings. At CAL, these concentrations were converted to mass emission form in pounds of pollutant per pound of fuel and the points plotted by computer. A curve was faired through the points, and from the faired curve a sufficient number of points were digitized and stored in the computer to permit interpolation over the entire range of power settings. Interpolation at specific power settings for the taxi-idle, takeoff, climbout and approach modes produced estimates of the corresponding fuel-flow rates and mass emission rates for CO, HC and NOX. Finally, these values were combined into estimates of the total CO, HC and NOX mass emissions for the entire cycle. The model summary provides, for each pertinent quantity in the calculation, the mean and standard deviation for the 11 engines tested. For example, one can examine such quantities as pounds of pollutant per pound of fuel for a specific mode, pounds of pollutant per hour for a specific mode, pollutant mass for a specific mode, pollutant mass for the entire cycle, and so on. Such an array of statistics, though it provides a wealth of information, is not readily assimilated and put to practical use. It is, in order, therefore, to attempt to make some generalizations concerning the statistical summaries and to provide some graphical aids to understanding.

Consider Table 2, which is a simplified and modified version of Table 1. Two additional types of calculation have been performed. First, the mass of each pollutant generated in a particular mode is expressed as a

TABLE 1

STATISTICAL SUMMARY OF AIRCRAFT ENGINE EXHAUST EMISSIONS

MODEL T56-A7 TURBOPROP SAMPLE NUMBER = 11.

MODE		EMISSION RATE LB/HR	FUEL RATE LB/HR	TIME IN MODE MIN.	CO MASS LBS.	FUEL MASS LBS.	LB CO / 1K LB FUEL	ENERGY HP-HR	LB CO / HP-HR
TAXI-IDLE	MEAN	15.268	548.004	19.00	4.835	173.53	28.101	35.67	0.13553
	STD DEV	3.519	54.095	0.0	1.115	17.13	6.597	0.04	0.03124
TAKEOFF	MEAN	2.150	2079.317	0.50	0.018	17.33	1.040	31.29	0.00057
	STD DEV	1.285	77.480	0.0	0.011	0.65	0.627	0.03	0.00034
CLIMBOUT	MEAN	3.009	1908.447	2.50	0.125	79.52	1.579	140.81	0.00089
	STD DEV	0.791	25.675	0.0	0.033	1.08	0.421	0.18	0.00023
APPROACH	MEAN	3.668	1052.900	4.50	0.275	78.97	3.482	84.49	0.00326
	STD DEV	0.841	23.937	0.0	0.063	1.79	0.787	0.14	0.00075
TAXI-IDLE	MEAN	15.268	548.004	7.00	1.781	63.93	28.101	13.14	0.13553
	STD DEV	3.519	54.095	0.0	0.411	6.31	6.597	0.01	0.03124
TOTAL FOR CYCLE				MEAN:	7.035	413.28		305.41	
				STD DEV:	1.502	24.11		0.0	
LBS POLLUTANT/1K LB FUEL/CYCLE				MEAN:	17.064				
				STD DEV:	3.570				
LBS POLLUTANT/1K HP-HR/CYCLE				MEAN:	23.033				
				STD DEV:	4.917				
LBS POLLUTANT/1000K HP-HR AT T.O.				MEAN:	0.477				
				STD DEV:	0.285				

MODE		EMISSION RATE LB/HR	FUEL RATE LB/HR	TIME IN MODE MIN.	HC MASS LBS.	FUEL MASS LBS.	LB HC / 1K LB FUEL	ENERGY HP-HR	LB HC / HP-HR
TAXI-IDLE	MEAN	6.474	548.004	19.00	2.050	173.53	11.923	35.67	0.05747
	STD DEV	1.612	54.095	0.0	0.511	17.13	3.054	0.04	0.01431
TAKEOFF	MEAN	0.430	2079.317	0.50	0.004	17.33	0.207	31.29	0.00011
	STD DEV	0.911	77.480	0.0	0.008	0.65	0.438	0.03	0.00024
CLIMBOUT	MEAN	0.476	1908.447	2.50	0.020	79.52	0.250	140.81	0.00014
	STD DEV	0.976	25.675	0.0	0.041	1.08	0.512	0.18	0.00029
APPROACH	MEAN	0.517	1052.900	4.50	0.039	78.97	0.491	84.49	0.00046
	STD DEV	1.004	23.937	0.0	0.075	1.79	0.952	0.14	0.00089
TAXI-IDLE	MEAN	6.474	548.004	7.00	0.755	63.93	11.923	13.14	0.05747
	STD DEV	1.612	54.095	0.0	0.188	6.31	3.054	0.01	0.01431
TOTAL FOR CYCLE				MEAN:	2.868	413.28		305.41	
				STD DEV:	0.705	24.11		0.0	
LBS POLLUTANT/1K LB FUEL/CYCLE				MEAN:	6.970				
				STD DEV:	1.745				
LBS POLLUTANT/1K HP-HR/CYCLE				MEAN:	9.390				
				STD DEV:	2.309				
LBS POLLUTANT/1000K HP-HR AT T.O.				MEAN:	0.955				
				STD DEV:	2.021				

MODE		EMISSION RATE LB/HR	FUEL RATE LB/HR	TIME IN MODE MIN.	NOX MASS LBS.	FUEL MASS LBS.	LB NOX/ 1K LB FUEL	ENERGY HP-HR	LB NOX/ HP-HR
TAXI-IDLE	MEAN	2.161	548.004	19.00	0.684	173.53	3.932	35.67	0.01918
	STD DEV	0.499	54.095	0.0	0.158	17.13	0.743	0.04	0.00443
TAKEOFF	MEAN	22.878	2079.317	0.50	0.191	17.33	10.984	31.29	0.00609
	STD DEV	3.566	77.480	0.0	0.030	0.65	1.501	0.03	0.00095
CLIMBOUT	MEAN	21.212	1908.447	2.50	0.884	79.52	11.111	140.81	0.00628
	STD DEV	2.314	25.675	0.0	0.096	1.08	1.154	0.18	0.00068
APPROACH	MEAN	7.776	1052.900	4.50	0.583	78.97	7.382	84.49	0.00690
	STD DEV	0.913	23.937	0.0	0.068	1.79	0.812	0.14	0.00081
TAXI-IDLE	MEAN	2.161	548.004	7.00	0.252	63.93	3.932	13.14	0.01918
	STD DEV	0.499	54.095	0.0	0.058	6.31	0.743	0.01	0.00443
TOTAL FOR CYCLE				MEAN:	2.594	413.28		305.41	
				STD DEV:	0.378	24.11		0.0	
LBS POLLUTANT/1K LB FUEL/CYCLE				MEAN:	6.269				
				STD DEV:	0.761				
LBS POLLUTANT/1K HP-HR/CYCLE				MEAN:	8.494				
				STD DEV:	1.237				
LBS POLLUTANT/1000K HP-HR AT T.O.				MEAN:	50.773				
				STD DEV:	7.914				

TABLE 2

MODEL T56-A7 TURBOPROP DATA Sample No. = 11

Mode		CO Mass Lbs.	Percent of Total CO For Cycle	HC Mass Lbs.	Percent of Total HC For Cycle	NOX Mass Lbs.	Percent of Total NOX For Cycle
TAXI-IDLE	Mean	4.835	68.73	2.050	71.48	0.684	26.37
	Std. Dev.	1.115		0.511		0.158	
	Coef.Var(%)	23.06		24.93		23.10	
TAKEOFF	Mean	0.018	0.26	0.004	0.14	0.191	7.36
	Std. Dev.	0.011		0.008		0.030	
	Coef.Var(%)	61.11		200.00		15.71	
CLIMBOUT	Mean	0.125	1.78	0.020	0.70	0.884	34.08
	Std.Dev.	0.033		0.041		0.096	
	Coef.Var(%)	26.40		205.00		10.86	
APPROACH	Mean	0.275	3.91	0.039	1.36	0.583	22.47
	Std.Dev.	0.063		0.075		0.068	
	Coef.Var(%)	22.91		192.31		11.66	
TAXI-IDLE	Mean	1.781	25.32	0.755	26.32	0.252	9.71
	Std.Dev.	0.411		0.188		0.058	
	Coef.Var(%)	23.07		24.90		23.02	
TOTAL FOR CYCLE	Mean	7.035	100.00	2.868	100.00	2.594	100.00
	Std.Dev.	1.502		0.70		0.378	
	Coef.Var(%)	21.36		24.41		14.57	

percentage of the total pollutant emitted over the entire LTO cycle. Second, each of the standard deviations in the table is expressed as a percentage of the corresponding mean. This quantity is known in statistical parlance as the coefficient of variation or the relative standard derivation. Its value lies in the fact that the standard deviation often is proportional to the mean; in such instances, the coefficient of variation tends to approach a constant value which is characteristic of the process being investigated.

Of particular note in Table 2 is the predominant influence of the taxi-idle mode on the total CO and HC for the cycle. The taxi-idle modes before takeoff and after landing are computed separately. If they are combined, then 94.05% of the CO and 97.80% of the HC for the LTO cycle was produced during taxi-idle mode operation. In the case of NOX, the partition is considerably different: only 36.08% of the NOX for the cycle was generated during taxi-idle mode operation. It appears, therefore, that errors associated with the taxi-idle mode may strongly determine the errors associated with the LTO cycle assessments for CO and HC, unless the coefficient of variation is disproportionately small for the taxi-idle mode and large for the other modes. In reality, this is not the case. For CO, the coefficient of variation is relatively constant and is approximately 21% of the mean for the entire cycle. In the case of HC, large coefficients of variation occur at takeoff, climbout and approach, but the magnitudes of the mean values for these modes are so small that the errors contribute little to the total for the cycle.* The coefficient of variation for the total HC for the cycle is approximately 24%. In the case of NOX, the coefficient of variation is relatively constant over all modes, and is approximately 15% for the total NOX for the cycle.

Consideration of the nature of the emissions vs. thrust curves makes it evident that for all the turboprop and thrust turbine engines tested, CO and HC contributions to the LTO cycle burden are dominated by the taxi-idle mode. In fact, the percentage of the total CO and HC produced during the taxi-idle mode appears to vary little among the various engine models tested. Though the coefficient of variation may depend to some extent upon the engine model, the test organization, and other factors, the range of values for the LTO-cycle totals is not extreme. The weighted averages of the coefficients of variation for CO, HC and NOX, as computed from the 145 engines in Table 3, are:

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* One might postulate that the large variation in these modes is due to the fact that the HC emissions are so low that they approach the limit of sensitivity of the instrumentation.

CO	30.64%
HC	46.76%
NOX	13.97%

For purposes of statistical inference, it will be convenient to consider 15%, 30% and 45% as nominal values of the coefficient of variation for NOX, CO and HC, respectively. Moreover, these values provide convenient increments for parametric study of the implications of statistical variation of various magnitudes.

A point to be noted in Table 3 is the fact that, for some models, the number of engines tested is somewhat less than is indicated in the table entry. In some instances a double entry, such as 7 (5) occurs. The first number is the number of tests included in the computation of the mean and standard deviation for that model. The presence of the number in parenthesis indicates that some of these tests were replicate or repeat tests on the same engine. The number (5) denotes that only 5 distinct or different engines were included in the summary calculation. As will be shown later, interpretation of such a set of tests as if it represented 7 different engines may exert a bias on determination of the standard deviation for that set. For present purposes, however, this bias is negligible, in view of the small number of cases in Table 3 in which replication occurs.

Let $\bar{x}$ denote the sample mean for a sample of N engines selected at random, each engine being tested once. Suppose that the population mean is μ and that the population standard deviation is

$$\sigma = p\,\mu$$

TABLE 3

LTO-CYCLE TOTAL MASS EMISSIONS

Engine Category	Test Organization	No. Engines		Pollutant Mass Total for Cycle (lbs)		
				CO	HC	NOX
T56-A7 Turboprop	SWRI Kelly	11	Mean	7.035	2.868	2.594
			Std.Dev.	1.502	0.705	0.378
			Coef.Var(%)	21.35	24.58	14.57
T56-A15 Turboprop	Allison	11	Mean	3.346	2.803	2.155
			Std.Dev.	1.506	1.815	0.579
			Coef.Var(%)	45.01	64.75	26.87
TPE-331 Turboprop	AiResearch	3	Mean	1.752	0.402	0.708
			Std.Dev.	0.235	0.244	0.239
			Coef.Var(%)	13.41	60.69	33.76
CJ-805	SWRI TWA	8 (4)	Mean	31.885	12.024	5.872
			Std.Dev.	6.547	3.297	0.466
			Coef.Var(%)	20.53	27.42	7.94
JT-3C	United EPA	4	Mean	55.385	39.232	7.649
			Std.Dev.	8.455	19.251	0.886
			Coef.Var(%)	15.26	49.07	11.58
JT-3C	SWRI TWA	3 (2)	Mean	29.044	42.290	6.412
			Std.Dev.	16.993	33.889	0.705
			Coef.Var(%)	58.51	80.13	11.00
JT-4A	SWRI TWA	8 (6)	Mean	29.852	28.402	12.015
			Std.Dev.	8.042	5.487	0.803
			Coef.Var(%)	26.94	19.32	6.68
SPEY 511-14	BuMines AA	4	Mean	29.405	28.912	8.391
			Std.Dev.	9.054	4.542	0.842
			Coef.Var(%)	30.79	15.71	10.03

TABLE 3 (Cont.)

LTO-CYCLE TOTAL MASS EMISSIONS

Engine Category	Test Organization	No. Engines		Pollutant Mass Total for Cycle (lbs)		
				CO	HC	NOX
JT-3D Production	Pratt & Whitney	5	Mean	38.527	19.873	6.844
			Std.Dev.	15.797	12.519	0.590
			Coef.Var(%)	41.00	63.00	8.62
JT-3D	SWRI TWA	7	Mean	46.979	37.919	7.021
			Std.Dev.	36.861	27.333	0.534
			Coef.Var(%)	78.46	72.08	7.61
JT-3D	United EPA	8	Mean	67.853	62.072	6.643
			Std.Dev.	20.378	25.257	0.535
			Coef.Var(%)	30.03	40.69	8.05
JT-3D	BuMines AA	2	Mean	40.500	48.322	8.255
			Std.Dev.	10.295	12.982	0.482
			Coef.Var(%)	25.42	26.87	5.84
JT-3D Experimental	Pratt & Whitney	4 (1)	Mean	42.766	43.263	9.386
			Std.Dev.	17.847	12.487	0.192
			Coef.Var(%)	41.73	28.86	2.05
JT-9D Production	Pratt & Whitney	5	Mean	40.199	8.732	29.708
			Std.Dev.	3.809	2.934	3.221
			Coef.Var(%)	9.48	33.60	10.84
JT-9D Experimental	Pratt & Whitney	4 (1)	Mean	55.146	16.461	33.623
			Std.Dev.	13.828	14.097	6.706
			Coef.Var(%)	25.07	85.64	19.94
JT-8D Undiluted Smokeless	SWRI TWA	18 (14)	Mean	17.292	3.869	6.891
			Std.Dev.	5.133	2.481	1.651
			Coef.Var(%)	29.68	64.13	23.96

TABLE 3 (Cont.)

LTO-CYCLE TOTAL MASS EMISSIONS

Engine Category	Test Organization	No. Engines		Pollutant Mass Total for Cycle (lbs)		
				CO	HC	NOX
JT-8D Undiluted Regular	SWRI TWA	7 (5)	Mean	19.615	3.701	5.565
			Std.Dev.	4.967	1.276	0.582
			Coef.Var(%)	25.32	34.48	10.46
JT-8D Diluted Smokeless	BuMines AA	10	Mean	13.207	3.385	10.243
			Std.Dev.	2.291	1.180	1.497
			Coef.Var(%)	17.35	34.86	14.61
JT-8D Diluted Smokeless	United EPA	4	Mean	11.285	2.327	8.451
			Std.Div.	7.547	1.926	0.533
			Coef.Var(%)	66.88	82.77	6.31
JT-8D Diluted Smokeless	Pratt & Whitney	8	Mean	16.148	2.945	10.907
			Std.Dev.	2.017	0.841	1.030
			Coef.Var(%)	12.49	28.56	9.44
JT-8D Diluted Regular	BuMines AA	5	Mean	21.143	6.045	8.638
			Std.Dev.	6.101	2.655	1.302
			Coef.Var(%)	28.86	43.92	15.07
JT-8D Diluted Regular	United EPA	2	Mean	17.936	2.543	8.389
			Std.Dev.	0.035	1.977	0.386
			Coef.Var(%)	0.19	77.74	4.60
JT-8D Experimental	Pratt & Whitney	4	Mean	28.051	4.058	11.922
			Std.Dev.	12.303	2.503	1.668
			Coef.Var(%)	43.85	61.68	13.99
	Weighted Average		Coef.Var(%)	30.64	46.76	13.97

where p is the coefficient of variation. The standard error of the random variable $\bar{x}$ is accordingly

$$\frac{\sigma}{\sqrt{N}} = p\mu/\sqrt{N}$$

If it is presumed that σ is known (or is adequately estimated by the analysis of Table 3), then a 95% confidence interval for μ is given by

$$\bar{x} - 1.96\, p\mu/\sqrt{N} \leq \mu \leq \bar{x} + 1.96\, p\mu/\sqrt{N}$$

This result appears circuitous in that μ would need to be known in order to establish the confidence interval, but if it were known there would be no need for a confidence interval. Suppose, however, that one considers only the width of the interval, which is

$$\bar{x} + 1.96\, p\mu/\sqrt{N} - \left(\bar{x} - 1.96\, p\mu/\sqrt{N}\right) = 3.92\, p\mu/\sqrt{N}$$

Then the width of the interval, expressed in terms of μ, is just

$$3.92\, p\mu/\sqrt{N} \div \mu = \frac{3.92\, p}{\sqrt{N}}$$

or the interval half-width is 1.96 $p/\sqrt{N}$.

This simple result can afford broad guidance both in interpreting the statistical consequences of existing exhaust measurements and in postulating the number of additional tests which might be required to increase confidence in the existing measurements or to establish baseline information for engine models not yet tested. It should be noted that a similar argument can be developed for other levels of confidence, say 99%. The 95% confidence level was selected, however, as the basis for further analysis. Confidence intervals based on the 95% level of probability provide a high degree of assurance that a particular interval will contain the population mean. Beyond 95%, the width of the interval (in terms of multiples of the standard deviation) increases rapidly for each additional 1% increase in confidence.

In Table 4 is tabulated the quantity 1.96 $p/\sqrt{N}$ for various values of p and N. The parameter p is varied in 15% increments from 15% to 75%; the parameter N is varied from 1 to 100 in intervals which are perfect squares. According to the table, for data with precision such that the coefficient of variation is 15%, approximately 9 tests would be required to reduce the half-width of the 95% confidence interval to 10% of the population mean, μ . Similarly, if the coefficient of variation is 30%, 36 tests would be required for the same purpose. If the coefficient of variation is as large as 45%, 81 tests would be necessary to determine the mean value to within 10% of its magnitude. On the basis of the coefficients of variation as estimated from Table 3, the numbers 9, 36 and 81 would apply approximately to total-cycle mass emissions for NOX, CO and HC respectively.

Two qualifications pertain to the above rough estimations. First, the numbers of tests indicated are based on control of random errors only. If a bias is involved, either as the result of instrumental errors or other causes, no amount of additional testing will guarantee a closer approximation to the mean values for mass emissions of NOX, CO and HC. Second, it must be realized that the above estimates are based on current experience in the measuring and assessment of emissions as practiced in the present program. As was previously pointed out, the mass emissions for the LTO cycle are dominated by taxi-idle mode operation in the case of CO and HC. Operation at low power settings produces a highly critical region in the curve which relates emissions to power or thrust. In this critical region, very small changes in power or thrust setting can produce very large changes in CO or HC emissions. In view of the subtle differences which might be expected to exist among engines in this respect, it is conceivable that one engine might be just over this critical region when operating at a specified fraction of rated power, whereas another engine might be just under the critical point when operating ostensibly at the same specified fraction of rated power. Moreover, it must be borne in mind that the rated power for a particular engine model is a nominal value; individual engines might be expected to vary somewhat from the nominal value. Consequently, 5% of the nominal rated thrust might be a slightly smaller or slightly larger fraction of the rated power or thrust if this rating were made for individual engines rather than for a "typical" engine of that model.

TABLE 4

FACTORS FOR CONFIDENCE INTERVALS
95% Confidence Bounds

		Coefficient of variation, n (%)				
		15	30	45	60	75
Sample Size, N	1	29.4	58.8	88.2	117.6	147.0
	4	14.7	29.4	44.1	58.8	73.5
	9	9.8	19.6	29.4	39.2	49.0
	16	7.4	14.7	22.0	29.4	36.8
	25	5.9	11.8	17.6	23.5	29.4
	36	4.9	9.8	14.7	19.6	24.5
	49	4.2	7.7	12.6	16.8	21.0
	64	3.7	7.4	11.0	14.7	18.4
	81	3.3	6.5	9.8	13.1	16.3
	100	2.9	5.9	8.8	11.8	14.7

Refinement of the testing procedure, either improvement in instrumentation or in the strategy of conducting the tests and analyzing the data, could conceivably materially decrease the statistical variation of exhaust emission assessments. In many of the tests, data were substantially missing in the critical "knee" of the CO and HC tests; in others, the lowest power or thrust setting employed in the test sequence was higher than the power or thrust setting specified as the taxi-idle mode. Estimation of the taxi-idle mass emission, so critical to the total LTO cycle calculation, was extremely difficult in such cases and was subject to considerable error arising from the necessity of a strongly subjective estimation process. In subsequent tests, care should be taken to better define the critical region of the curves by allocation of more test points to low levels of thrust power.

Though individual tests for a particular engine may have been sparse in data points, the aggregation of a number of engines of a particular model tends to reinforce the sparse regions. Where points might be missing for one engine, they might be present in another, and this fact was taken advantage of in the fairing of the individual curves. The success achieved in this way can be seen in Figure 1, in which the CO test points for all engines in the T56-A7 turboprop category are plotted to produce a composite graph. The small circles denote actual test points as converted to the basis of pounds of pollutant per pound of fuel. Now it will be recalled that for each engine an individual emission curve has been previously drawn for each of the pollutants, and these curves were used to interpolate for emissions at the specified power or thrust values defined as being applicable at taxi-idle, takeoff, climbout and approach. Finally, averages and standard deviations were computed for these mode estimates by combining all engines in the particular category. These average values are represented by crosses in the composite plots; the lines through the crosses extend to one standard deviation above and below the average values. It should be pointed out that in some instances the average as plotted for the taxi-idle mode may appear to be too high for the adjacent data points. Closer examination will often reveal, however, that these data points were such as to necessitate extrapolation. If the average includes many extrapolated values, it will be, and quite properly so, higher than the adjacent data points. To augment the four modes used in the LTO cycle calculation, a point in the knee of the curve was included to better define that region of the composite curve.

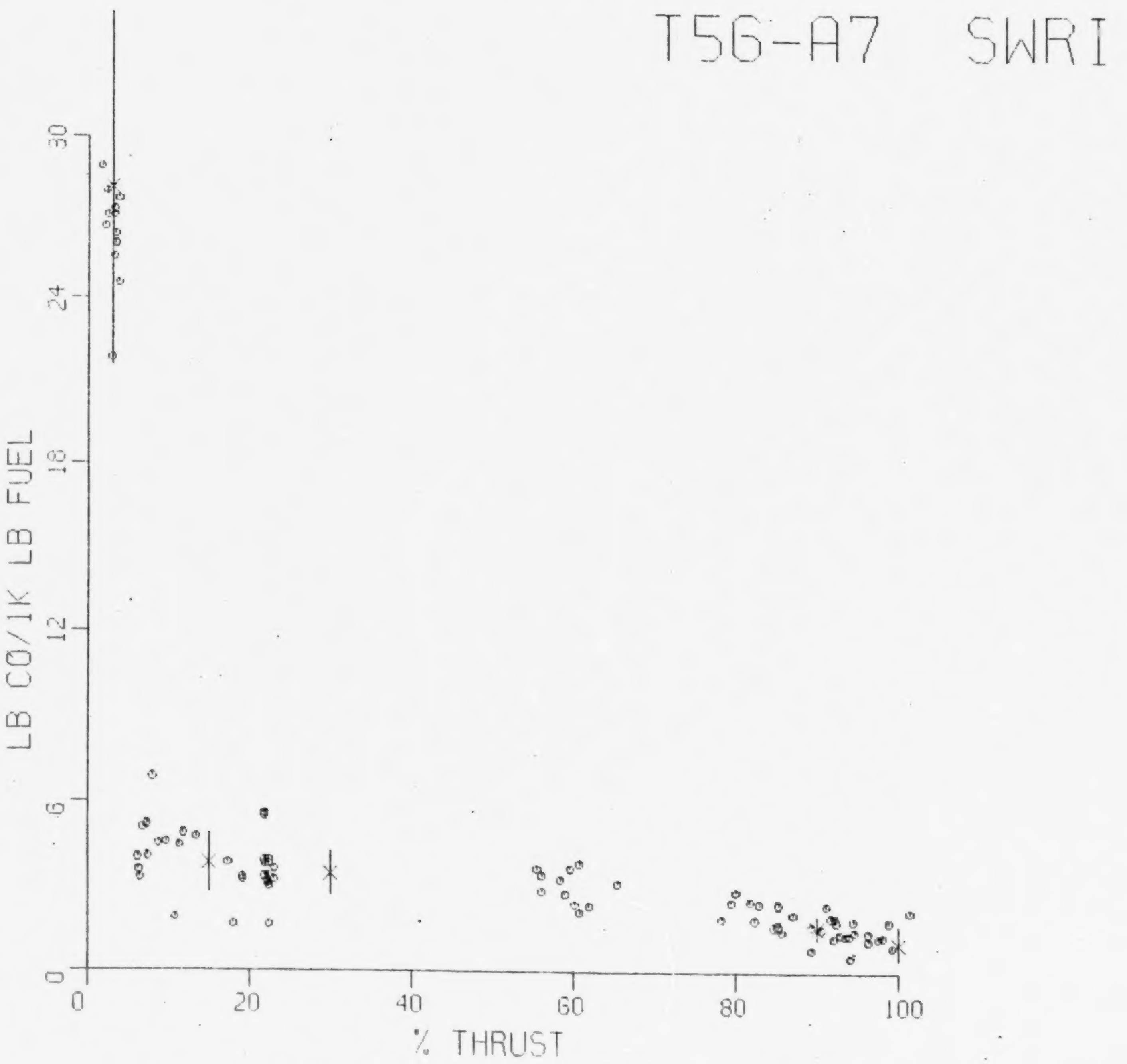

Figure 1 COMPOSITE PLOT OF AIRCRAFT ENGINE EXHAUST EMISSIONS

A compilation of composite plots for the various engine categories of interest in this investigation can be found in Appendix I.

In general, it will be observed that:

1) The dispersion of points is much greater at high levels of emission than at low levels.
2) The one-standard-deviation error bands indicated for the interpolated points are compatible with the scatter of the observed or "raw" data points.
3) A curve drawn through the average mode values, as given by the crosses, would provide a "reasonable" fit to the composite cloud of raw data points.

The graphs thus lend credibility to the semi-subjective, semi-automatic procedure used to obtain emissions over the LTO cycle and to the hypothesis that errors tend to be directly related to the magnitude of the quantities being assessed.

3.1 Within-Engine Versus Between-Engines Variability

It has been indicated that a certain amount of variation in measured emissions is introduced by uncontrolled variables in the testing operation and by certain necessary compromises in the data reduction process. Also, it has been suggested that by further refinement of technique, it might be expected that the variation induced by these causes might be reduced. Even if these sources of error were completely eliminated, however, there would be differences between engines of a particular model. These differences are the result of factors peculiar to each engine and would not be eliminated even by a "perfect" or error-free test procedure and measurement process. In such an ideal case, it would hypothetically be possible to perform repeat or replicate tests on a particular engine and obtain exactly the same measured emissions each time.

A different engine, however, would give different results, results peculiar to its own "personality." In reality, of course, such an ideal situation does not and probably could not exist. Replicate tests of a particular engine do not give identical results, and the variance observed in these replicate tests provides a measure of "within-engine" variance. We are tempted to refer to this variance as "run-to-run variability", where by a "run" is meant a series of tests on a particular engine. When many engines of a model are tested, there is superimposed on this "within-engine" variability a "between-engines" variability. This variability might also be referred to as "engine-to-engine variability", in that it denotes the variance induced when the test operation is changed from one engine to another. Understanding of the relative magnitudes of these two sources of variance will provide insight into how to more effectively improve testing strategy as well as to indicate the degree of latitude which might be appropriate in emission standards to allow for the natural variation among engines of a particular model or type.

Estimation of the "repeatability" of emissions measurements--that is, the "within-engine" variability alluded to above-- can best be achieved by replicate tests set up for that purpose. In particular, it is desirable that k engines be selected at random and that each of these k engines be tested n times to produce kn emissions assessments. From this two-way table of measurements one can extract, by analysis of variance, the variance components associated with engine-to-engine variability and with test variables.

Unfortunately, replicate tests of turboprop and thrust turbine engines exist in only a few, isolated cases which do not lend themselves well to a systematic decomposition of errors according to source. In the case of piston engines, however, a fairly extensive set of data well-structured for such analysis is provided by the Scott Research Laboratories tests on light utility aircraft engines. A summary of these tests is found in the Phase I report.

Table 5 was prepared by abstracting data from the Phase I report. The table presents total CO, HC and NO emissions for 7 engines of the 0-320 type as computed over a specified LTO cycle. Each of the 7 engines was tested three times--that is, three replicates are available for each engine.

TABLE 5

ANALYSIS OF VARIANCE
FOR SEVEN 0-320 PISTON ENGINES

CO TOTAL FOR CYCLE (LBS)

	11.569	11.136	9.822	12.875	6.795	11.532	17.058
	10.675	11.394	11.525	11.308	4.537	10.108	15.328
	10.424	13.252	14.304	11.070	9.458	10.699	16.276
Mean	10.889	11.928	11.884	11.751	6.930	10.780	16.221
Std. Dev.	0.602	1.155	2.262	0.981	2.463	0.716	0.867

Mean Squares Among Engines	(6 d.f.)	22.2266
Mean Squares Within Engines	(14 d.f.)	2.1582
F Ratio		10.2989
Among - Engines Component of variance		6.6895
Combined Variance: Within + Among		8.8476
Intra-Class Correlation Coefficient		0.7561
Combined Standard Deviation		2.9745

HC TOTAL FOR CYCLE (LBS)

	0.280	0.467	0.348	0.199	0.148	0.293	0.347
	0.574	0.372	0.326	0.187	0.112	0.185	0.252
	0.356	0.347	0.383	0.175	0.183	0.199	0.268
Mean	0.404	0.395	0.352	0.187	0.147	0.225	0.289
Std. Dev.	0.153	0.064	0.029	0.012	0.036	0.059	0.051

Mean Squares Among Engines	(6 d.f.)	0.031435
Mean Squares Within Engines	(14 d.f.)	0.005100
F Ratio		6.163188
Among - Engines Component of Variance		0.008778
Combined Variance: Within + Among		0.013879
Intra-Class Correlation Coefficient		0.632496
Combined Standard Deviation		0.117808

NO TOTAL FOR CYCLE (LBS)

	0.0131	0.0	0.3743	0.0274	0.0239	0.0136	0.0086
	0.0094	0.0	0.1277	0.0281	0.1044	0.0123	0.0125
	0.0081	0.1306	0.0216	0.0176	0.0153	0.0126	0.0083
Mean	0.0102	0.0435	0.1746	0.0244	0.0478	0.0128	0.0098
Std. Dev.	0.0026	0.0754	0.1810	0.0058	0.0492	0.0007	0.0023

Mean Squares Among Engines	(6 d.f.)	0.010349
Mean Squares Within Engines	(14 d.f.)	0.005843
F Ratio		1.771275
Among - Engines Component of Variance		0.001502
Combined Variance: Within + Among		0.007345
Intra-Class Correlation Coefficient		0.204513
Combined Standard Deviation		0.085701

The logic of the analysis in Table 5 can be appreciated by heuristic reasoning. For example, consider the results for total CO emissions over the LTO cycle. The first group of three measurements constitute three replications on the same engine. The mean for these three measurements can be computed and the standard deviation computed with respect to that mean. The standard deviation squared is, of course, the corresponding variance; this variance ostensibly arises from factors affecting the individual runs and in no way can experience a between-engines effect. The individual variance estimates for the seven columns of CO measurements can be "pooled" -- that is, averaged -- to obtain a "best estimate" of the within-engine variance, called in the table "mean squares within engines." Now suppose one considers the entire set of 21 measurements in the manner employed in the Phase I report, as if they represented 21 distinct engines. The grand mean for the 21 measurements is 11.483; the standard deviation of the 21 measurements, computed with respect to the grand mean, is 2.860. Quite clearly, this result is a measure of some mixture of the within-engine and among-engines effects. By appropriate correction of this result for the separately computed within-engine component, one can obtain the between-engines component of variance. Details of the method need not be discussed here, since they are presented in standard statistical texts.* Suffice it to say that two pertinent quantities can be derived in this way: mean squares among engines and mean squares within engines. The first quantity has associated with it 6 degrees of freedom (d.f.), one less than the number of engines. The second quantity has 14 degrees of freedom, 2 for each of the 7 columns. By dividing mean squares among by mean squares within, one obtains the F ratio

$$F = \frac{22.2266}{2.1582} = 10.2989$$

Referring to a table of the F distribution, one finds that the 5% critical value for 6 and 14 degrees of freedom is 2.85 and that the 1% critical value is 4.69. The computed value of 10.2989, exceeds even the 1% critical value, so it can be concluded that the engine-to-engine variance is significant at better than the 1% level. To appreciate the meaning of this conclusion, suppose that no engine-to-engine variability existed and one had performed the same type of analysis. Under these conditions, called the conditions of the null hypothesis, an F-ratio as large as 4.69 or larger would occur very rarely, only 1% of the time. It is thus unlikely that the observed F-ratio, 10.2989, could have occurred by chance.

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* See, for example, G.W. Snedecar, Statistical Methods, Fifth Edition, Iowa State College Press, Ames, Iowa, 1956.

By the methods of analysis of variance, it can be shown that the quantity called mean squares among engines is an estimate of $\sigma_w^2 + 3\sigma_A^2$, where σ_w^2 is the within-engine component of variance and σ_A^2 is the between-engines component of variance. As previously noted, the mean squares within engines is an estimate of σ_A^2 only.

Setting

$$\sigma_w^2 + 3\sigma_A^2 = 22.2266$$

and

$$\sigma_w^2 = 2.1582$$

one obtains two equations which can be solved for σ_w^2 and σ_A^2 to obtain

$$\sigma_A^2 = 6.689.$$

The sum of the two variance components gives

$$\sigma_w^2 + \sigma_A^2 = 2.1582 + 6.6895 = 8.8476.$$

This combined variance is an estimate of the variance which would be obtained if single tests were run on individual engines, so that the within and among effects are equally weighted. The square root of this quantity, called combined standard deviation, is an estimate of the corresponding standard deviation.

Consider, now, the ratio of the among-engines component of variance to the combined variance:

$$\frac{\sigma_A^2}{\sigma_w^2 + \sigma_A^2} = \frac{6.6895}{8.8476} = 0.7561$$

This ratio, called the intraclass correlation coefficient, is that fraction of the combined variance which is attributable to engine-to-engine variability.

Examination of the results for HC emissions reveals that engine-to-engine variability is also significant here at better than the 1% level (F ratio = 6.16). In this instance, over 63% of the combined variance is attributable to engine-to-engine variability.

In the case of the NO results, it is evident from examination of the input data that the measurements are somewhat erratic. This fact is reflected in the F-ratio of 1.77, which fails to reach even the 5% level of significance. Even if one were to consider engine-to-engine variability significant, the best available estimate of its magnitude places it at approximately 20% of the combined variance.

Analysis of variance can be performed on any of the quantities evolving from the LTO-cycle calculation: pounds of pollutant per pound of fuel for individual modes, pounds of pollutant per hour for individual modes, pollutant mass for each mode, and so on. An extensive compilation of these results is given in Appendix II. These results are included as a source of information on the partitioning of variance between engine and test-variable sources.

A word of explanation is in order concerning the negative quantities which occasionally occur in the analysis of variance. In the solving of the two equations

$\sigma_w^2 + 3\sigma_A^2$ = mean squares among engines

σ_w^2 = mean squares within engines

it must be appreciated that the mean squares are sample realizations of two random variables, whereas σ_w^2 and σ_A^2 are expected values, or population parameters. Because of this fact, a set of values may occasionally occur in which the means of engine replicates vary less than would be anticipated on the basis of the individual variation observed among the replicates themselves. Thus σ_A^2 appears to be a negative quantity, an obvious mathematical impossibility. Clearly no useful information regarding the partitioning of variance can be obtained in such instances. It will usually be observed, however, that in such cases the F-ratio will often be non-significant, and further analysis might be considered to be precluded by this fact. By general overall assessment of the data contained in Appendix II, however, one can obtain considerable insight into the variance-component disposition.

The prospect of spurious results in isolated cases of analysis of variance makes evident the risk involved in attempting to draw conclusions from the isolated cases of replicate data available for turboprop and thrust turbine engines. Nevertheless, one can obtain some appreciation of the variability which can occur from testing variables alone, even when these tests are conducted on the same engine and under as nearly identical conditions as possible. For example, in the testing program performed by Pratt and Whitney, replicate tests were performed on three experimental engines, one JT3D, one JT8D and one JT9D. The results obtained on these engines are statistically summarized in Appendix III; an abbreviated summary, based only on total emissions over the LTO cycle, is presented in Table 6.

The results of Table 6 present an anomaly in that the statistical variation observed among replicates on the experimental engines is greater than that observed among individual tests of different engines in the production categories. If the same spectrum of testing errors applied to both the experi-

TABLE 6

LTO - CYCLE TOTAL MASS EMISSIONS

Engine Category	No. Items		Pollutant Mass Total For Cycle (lbs.) CO	HC	NOX
JT-3D Exp.	4	Mean	42.766	43.263	9.386
		Std. Dev.	17.847	12.487	0.192
		Coef. Var.(%)	41.73	28.86	2.05
JT-3D Prod.	5	Mean	38.527	19.873	6.844
		Std. Dev.	15.797	12.519	0.590
		Coef. Var.(%)	41.00	63.00	8.62
JT-8D Exp.	4	Mean	28.051	4.058	11.922
		Std. Dev.	12.303	2.503	1.668
		Coef. Var.(%)	43.86	61.68	13.99
JT-8D Prod.	8	Mean	21.143	6.045	8.638
		Std. Dev.	6.101	2.655	1.302
		Coef. Var.(%)	28.86	43.92	15.07
JT-9D Exp.	4	Mean	55.146	16.461	33.623
		Std. Dev.	13.828	14.097	6.706
		Coef. Var.(%)	25.08	85.64	19.94
JT-9D Prod.	5	Mean	40.199	8.732	29.708
		Std. Dev.	3.809	2.934	3.221
		Coef. Var.(%)	9.48	33.60	10.84

mental and production engines, it would be expected that the variance for the production category would be greater than for the experimental category because the production category is affected by engine-to-engine variability, whereas the experimental category is not. It appears, therefore, that test variability is, for some reason, greater for the experimental engines than for the production engines. Part of this difference may reside in the fact that the experimental engines are rated at a somewhat higher thrust value than are the production engines. Mean values for the pollutant mass for the cycle are in many cases higher for the experimental engines than for the corresponding production engines; this fact, if it represents a real difference in pollutant output, might also be a factor influencing the greater variability noted for the experimental engines. Because of the anomalies noted above, therefore, it is not feasible to attempt to estimate engine-to-engine variability by comparing the replicated and non-replicated tests of JT3D, JT8D, and JT9D engines tested by Pratt and Whitney. The replicate tests do indicate, however, that the coefficient of variation for replicate tests may in some instances be at least as great as the weighted average values derived from Table 3. Further tests conducted in somewhat the same manner as the Scott tests of piston engines would be required to answer more definitely the question of the relative importance of engine-to-engine and run-to-run variability.

A limited amount of data suitably structured twoard this end is provided by replicate tests performed on four JT8D engines tested by the SWRI-TWA team. The results obtained for these engines over the LTO cycle for CO, HC and NOX are summarized in Table 7. According to analysis of variance, the among-engines variability is not significant and, in fact, the results are such as to imply that engine-to-engine variability is negligible relative to the testing variation. It is to be noted, however, that the amount of data is so small as to make these conclusions uncertain, particularly in view of the fact that in the case of the CO and HC analyses, one of the observations appears inconsistent with the remaining observations and might be regarded as an "outlier." As previously noted, more data would be required

TABLE 7

ANALYSIS OF VARIANCE FOR FOUR JT8D ENGINES

CO TOTAL FOR CYCLE (lbs.)

	25.792	12.967	18.547	15.395
	14.823	12.016	15.663	15.367
Mean	20.308	12.492	17.105	15.381
Standard Deviation	7.756	0.673	2.039	0.022
Mean Squares Among Engines			(3 d.f.)	21.3703
Mean Squares Within Engines			(4 d.f.)	16.1927
F Ratio				1.3197
Among-Engines Component of Variance				2.5889
Combined Variance: Within + Among				18.7816
Intra-Class Correlation Coefficient				0.1378
Combined Standard Deviation				4.3338

HC TOTAL FOR CYCLE (lbs.)

	12.816	2.224	4.136	4.390
	1.869	2.253	4.317	4.996
Mean	7.342	2.239	4.226	4.693
Standard Deviation	7.741	0.021	0.128	0.429
Mean Squares Among Engines			(3 d.f.)	8.8291
Mean Squares Within Engines			(4 d.f.)	15.0297
F Ratio				0.5874
Among-Engines Component of Variance				-3.1003
Combined Variance: Within + Among				11.9294
Intra-Class Correlation Coefficient				-0.2599
Combined Standard Deviation				3.4539

NOX TOTAL FOR CYCLE (lbs.)

	6.877	5.760	6.398	6.130
	8.087	5.314	6.578	12.186
Mean	7.482	5.537	6.488	9.158
Standard Deviation	0.856	0.315	0.127	4.282
Mean Squares Among Engines			(3 d.f.)	4.7850
Mean Squares Within Engines			(4 d.f.)	4.7963
F Ratio				0.9976
Among-Engines Component of Variance				-0.0056
Combined Variance: Within + Among				4.7907
Intra-Class Correlation Coefficient				-0.0012
Combined Standard Deviation				2.1888

to obtain a bona fide estimation of the relative importance of run-to-run and engine-to-engine variability.

In Appendix III can be found a compilation of the limited number of replicate analyses available on turboprop and thrust turbine engines.

3.2 Factors Affecting Exhaust Emissions

The ability to draw conclusions regarding the effect of such factors as engine age and ambient conditions on aircraft engine exhaust emissions depends on a number of factors. First, any apparent effects must be evaluated with respect to their statistical significance. In the case of data in which the standard deviation of observations may be as much as 50% of their average value, the apparent effects must be relatively large in order to be judged statistically significant, unless a fairly large number of replicate measurements are available. Second, the apparent effects must be capable of being identified with specific causes. For example, let us suppose that a significant difference has been established between the mean CO mass output over the LTO cycle for two groups of engines of the same type. If one of these groups represent new engines and the other represents used engines, and if this difference in age is the only factor which distinguishes one group of engines from the other, then it might be concluded that the observed difference in emissions was the result of the difference in engine age. If, however, the two groups of engines were tested by different test organizations and at two different geographical locations, it would be difficult to ascribe the observed difference to age, since it might have been at least partially due to differences in test methodology or prevailing environmental conditions. In the latter case, the effect of engine age is said to be confounded with other factors which might have been responsible for the differences in emissions observed.

To test whether the difference between the two means can be regarded as statistically significant, one frequently makes use of a device known as a "t-test". To apply the test, one formulates the null hypothesis

$$H_0 : \mu_1 = \mu_2$$

where μ_1 and μ_2 are the population means for the two categories of data being compared. Of course, only the sample means $\bar{x}_1$ and $\bar{x}_2$, each based on a relatively small number of observations, are available. These sample means are almost certain to appear numerically different-- that is, it is quite unlikely that they will be identical in magnitude. On the basis of the considerations of Table 4, however, it is evident that relatively large fluctuations in the value of either $\bar{x}_1$ or $\bar{x}_2$ can occur as a result of sampling variation, even though the samples are drawn from the same population. Now, if one considers the differences between two successively drawn samples, the variation in these differences is even greater: the standard error of the difference between the means is approximately $\sqrt{2}$ times the standard error of the means being compared. It becomes necessary, therefore, to regard quite critically any apparent difference between means to assure that the observed difference is not a chance occurrence having no relevance to the causes under consideration.

A broad assessment of what constitutes or does not constitute a significant difference between means can be had by modification of Table 4. In that table, the magnitude of the standard deviation of observations is assumed to be known as a fraction of the mean value of the observations. Multiplying the entries in Table 4 by $\sqrt{2}$ results in Table 8, which provides an estimate of the "least significant difference" which would be required between two means $\bar{x}_1$ and $\bar{x}_2$ to declare the difference significant at the 5% level of significance. The entries in the table are the minimum differences between means, expressed as a percent of their average value, which would be required to establish significance at the 5% level if each of the means derives from a sample of N measurements. Thus, for example, for data which normally exhibits a 30% coefficient of variation, two means, each based on 16 measurements, would have to differ by more than 20% of their mid-value in order to be declared significantly different at the 5% significance level. In view of the fact that 15%, 30% and 45% represent respectively estimates of the coefficient

TABLE 8

LEAST SIGNIFICANT DIFFERENCE BETWEEN MEANS

0.05 Significance Level

		Coefficient of variation, p (%)				
		15	30	45	60	75
Sample Size, N	1	41.6	83.2	124.7	166.3	207.9
	4	20.8	41.6	62.4	83.2	103.9
	9	13.8	27.7	41.6	55.4	69.3
	16	10.5	20.8	31.1	41.6	52.0
	25	8.3	16.7	24.9	33.2	41.6
	36	6.9	13.9	20.8	27.7	34.6
	49	5.9	10.9	17.8	23.8	29.7
	64	5.2	10.5	15.6	20.8	26.0
	81	4.7	9.2	13.9	18.5	23.0
	100	4.1	8.3	12.4	16.7	20.8

of variation for NOX, CO and HC, the entries in these columns can be used as a general guide for judging the significance of differences between two categories of engines, such as new and in-use or engines tested by two different test organizations. If the number of engines in the two groups being compared are unequal, the approximate least significant difference can be determined by interpolation.

As in the case of confidence intervals, the choice of significance level to be used in establishing least significant differences is to some extent arbitrary. From a practical consideration, this choice is a compromise between the risk of declaring a difference significant when it is not (Type 1 error) and declaring a difference to be not significant when in reality it is (Type 2 error). At the 5% significance level, errors of the first type would occur with probability 0.05. Therefore if the difference between two results (such as that obtained by two organizations) is declared significant, one can have reasonable assurance that the difference is not due simply to sampling variation. Discussion of the implications of Type 2 errors is beyond the scope of this document. By the methods outlined, however, one can construct other criteria for judging significance if a different level of significance is indicated by consideration of the consequences of the two types of error.

Within the framework of a 5% significance level, Table 8 can be used in a broad evaluation of comparisons of interest in Table 3 and Table 6.

For example, consider results obtained in the testing of JT3C engines by the United Aircraft-EPA team and the SWRI-TWA team. For CO and HC, the two mean values are centered on approximately 40 pounds of pollutant per cycle. Approximately 4 tests were available in each group, so that it might be concluded that if the difference between means for CO is greater than 41.6% of this value, or about 17 pounds CO, one can adjudge the difference to be significant. Since the observed difference is considerably greater than 17 pounds CO, the difference is significant. In the case of HC, however, significance is not reached. In the case of NOX, the observed difference is approximately 1.2 pounds NOX, or approximately 17% of the average of the NOX values reported by the two organizations. Though this difference approaches the minimum difference required for significance, it is less than conclusive. It must be emphasized, however, that slavish adherence to the dictates of Table 7 should be avoided, because the values given are based on an estimated value for the coefficient of variation, and this value was further rounded to even 15% increments. For this reason, the NOX difference might be regarded as marginally significant rather than being labeled not significant. In short, it is suggested that the table be employed as a general guideline to significance statements and that it be tempered with an appropriate measure of discretion.

With the above philosophy in mind, a number of comparisons were made, as shown in Table 9. In this table the marginal entries are the categories being compared, and the intersection of a particular row and column contains an assessment of the significance of that comparison. The presence of the symbols CO, HC or NOX in this position denotes that the coresponding comparisons were judged to be significant or at least worthy of further consideration. If a symbol is missing from the cell, its absence denotes that the observed difference did not reach the magnitude required (considering the size of the samples involved) to be considered significant. Thus if the cell is completely empty, no significant difference was observed for either CO, HC or NOX.

Table 9 does not attempt to exhaust all the possible comparisons which might be made or which might be of interest to the reader. By the methods suggested, however, other comparisons can be made as appropriate to the questions of concern. The logic of these comparisons is based on the assumption that an overall average of coefficients of variation obtained by pooling all turbine engines tested is more reliable than local estimations made on the basis of the categories actually being compared. It can not be contended that the significance level of 5% is precisely achieved in all comparisons, nor is that the intent of the analysis. Rather, the intent is to provide a rational scheme by which comparisons can be screened according to a decision rule approaching uniformity.

TABLE 9

COMPARISONS OF VARIOUS CATEGORIES OF EXHAUST
EMISSIONS TESTS

	JT 3C SWRI - TWA (3) 29.0-42.3-6.4	JT 3D P&W EXPT. (4) 42.8- 43.3-9.4	JT 8D UNDIL-REG SWRE-TWA (7) 19.6-3.7-5.6	JT 9D P&W EXPT. (4) 55.1-16.5-33.6
JT 3C UNITED-EPA (4) 55.4 - 39.2 - 7.6	NOX	NOX	CO HC NOX	HC NOX
JT 3D BuMINES - AA (2) 40.5 - 48.3 - 8.3			CO HC NOX	HC NOX
JT 3D P&W PROD (5) 38.5 - 19.9 - 6.8	HC	HC NOX	CO HC NOX	NOX
JT 8D UNDIL-SMOKELESS SWRI-TWA (18) 17.3 - 3.9 - 6.9	CO HC	CO HC NOX	NOX	CO HC NOX
JT 9D P&W PROD (5) 40.2 - 8.7 - 29.7	HC NOX	HC NOX	CO HC NOX	HC

Note: Table entries imply significant differences at the 5% level of significance.

In Appendix IV are statistical summaries of various homogeneous categories of aircraft engine emissions tests. The basis of homogeneity may be test organization, whether the engine is or is not equipped with smokeless burner can retrofits, and so on. These summaries, together with the least-significant differences of Table 8, can be used in further statistical comparisons.

3.2.1 Differences Between Test Site Locations

One of the questions of interest in the analysis of engine test data is whether significant differences are observed between test sites if attention is restricted to a particular type of engine. In Table 9 was presented an example of a significant difference between tests on the same-model engine (JT3C) by two different test organizations (SWRI-TWA and United-EPA). Any of a number of factors could have contributed to this difference, however. In addition to different locations of test sites, one must bear in mind the fact that actually different engines were tested and that differences in sample train, instrumentation and other factors could have existed. In view of the manner in which the data were processed, there could even have been differences arising from the interpolative process and the manner in which these differences propagated in the computation of mass emissions over the LTO cycle. In view of such confounding influences, it is difficult to establish the actual cause of the observed differences. More carefully controlled tests aimed at isolating extraneous factors would be required in order to be definitive on this point.

3.2.2 Effect of Engine Age

In view of the fact that significant differences can occur between test organizations for a variety of reasons, any study of the effect of engine age or time since overhaul of the hot section should preferably be restricted to tests performed by a single test organization. This fact restricts severely the number of engines available for age comparisons since it precludes comparison of new engines tested by one organization with in-use engines tested by another. In addition, differences in ambient conditions may occur between tests of new engines and old engines. If these ambient conditions influence emissions, they may tend to confound or obscure the effects of engine age. In a well-designed experiment, care could be taken to balance out these extraneous effects or to adjust the engine-age effects for any perturbing effect of ambient test conditions. Though regression analysis can sometimes be employed for this purpose, its use in the present analysis is discouraged because of the limited number of cases available for analysis in a particular homogeneous subset of engines tested.

The set of data most amenable to a study of the effects of engine age are the 18 tests performed by the SWRI-TWA team on JT8D engines equipped with smokeless burner cans. In this set of tests are 7 performed on engines with newly overhauled hot sections and 3 tests on engines having less than 500 hours service since overhaul of their hot sections. The remaining 8 tests were performed on engines which, with one exception of 1027 hours, had operated several thousand hours since such overhaul. The number of engines tested is large enough to assure at least some degree of balance in ambient conditions.

In Table 10, the two subsets of JT8D engines are tabulated according to time since overhaul of the hot section. Ambient conditions which might influence the comparison, such as specific humidity, temperature and atmospheric pressure, are listed and averaged for the two subsets. Though it is not assured that the effects of these ambient variables, if they exist, are linear, it can be assumed that the values of these disturbing variables are to some extent distributed so as to compensate for their influence on the average results for the two subsets of engines tested.

In view of the requirements set forth for least significant difference in Table 8, neither CO nor HC mass emissions over the LTO cycle reach the 5% significance level. By strict interpretation of the table, the NOX emissions over the LTO cycle show a significant effect for time since hot-section overhaul. Attention is called to the fact, however, that this result hinges strongly on one determination, 12.186, which is considerably higher than the remaining

TABLE 10

EFFECT OF ENGINE AGE ON EXHAUST EMISSIONS

CAL ID No.	Time Since Overhaul (hrs)	Specific Humidity*	Temperature (°F)	Atmospheric Pressure**	POLLUTANT MASS TOTAL FOR CYCLE (lbs.)		
					CO	HC	NOX
Engines with less than 1000 hrs. operation since overhaul of the hot section							
275	0	0.0123	81.0	28.88	13.860	2.420	7.658
280	0	0.0161	82.0	28.81	13.433	2.721	6.289
283	0	0.0107	73.0	28.83	12.215	1.233	6.110
284	0	0.0130	66.5	28.90	18.547	4.136	6.398
286	0	0.0076	67.5	28.98	15.663	4.317	6.578
305	0	0.0152	79.0	28.92	23.561	3.437	6.711
332	0	0.0121	87.0	29.05	18.805	3.782	6.856
287	242	0.0110	58.0	29.00	31.105	4.963	6.673
303	460	0.0129	78.0	28.82	15.395	4.390	6.130
304	460	0.0129	80.0	28.97	15.367	4.996	12.186
Average	116	0.0124	75.2	28.92	17.795	3.640	7.158
Engines with more than 1000 hrs. operation since overhaul of the hot section							
110	6144	0.0171	80.0	28.81	25.792	12.816	6.877
112	3343	0.0131	72.5	28.92	15.190	3.447	9.056
114	6144	0.0133	81.0	28.94	14.823	1.869	8.087
277	3142	0.0164	77.0	28.94	12.967	2.224	5.760
278	3142	0.0174	76.5	28.78	12.016	2.253	5.314
279	1027	0.0141	71.0	28.82	21.336	4.422	4.578
288	2945	0.0107	63.0	29.02	15.489	3.298	6.381
330	2937	0.0113	65.0	29.12	15.693	2.925	6.404
Average	3603	0.0142	73.2	28.90	14.812	3.695	5.829

* Pounds water per pound of air

** Inches of mercury

determinations in the set and might be considered an "outlier". In short, evidence of a significant effect of engine age on emissions is not conclusive. On the basis of available information, the effect, if real, would appear to be small relative to the magnitude of reductions in emissions which might be contemplated in the setting of emission standards.

A complete statistical summary of the two sets of engines examined above is given in Appendix IV.

3.2.3 Effect of Ambient Conditions

The effect of ambient conditions on pollutant levels is one of the questions of interest in connection with aircraft engine exhaust emissions. As has been previously noted, different test organizations may report significantly different emissions for comparable categories of engines and the source of these differences may not be identifiable. For that reason, it is preferable to restrict attention to a particular test organization when considering the effects of ambient conditions on emissions. Moreover, to avoid confounding environmental effects with any effect of engine age, it is desirable to work with data which is not subject to variation in engine age. These restrictions limit the number of engines available for the study of ambient conditions and, because of this limitation and the others mentioned, may curtail the range of such variables as specific humidity, atmospheric pressure and temperature.

A set of engines homogeneous with respect to test organization and engine age is the collection of eleven new T56-A15 engines tested by Allison. These engines are tabulated in Table 11, together with ambient conditions and the CO, HC and NOX total emissions over the cycle.

It should be noted that if more than one of the ambient factors exerts an influence on emissions, it will be difficult to ascertain the separate effects of inlet humidity, inlet temperature and atmospheric pressure on pollutant levels. However, by means of regression analysis, one can attempt to

TABLE 11

EFFECT OF AMBIENT CONDITIONS ON T56-A15 AIRCRAFT ENGINE EXHAUST EMISSIONS

CAL ID Number	Inlet Humidity *	Inlet Temperature (°F)	Atmospheric Pressure **	POLLUTANT MASS TOTAL FOR CYCLE		
				CO	HC	NOX
18	0.0096	80.00	29.26	1.669	2.794	2.726
19	0.0094	90.00	29.27	2.182	2.691	2.258
20	0.0115	82.00	28.90	4.919	5.662	2.054
21	0.0140	83.00	29.21	3.596	2.026	1.487
22	0.0155	74.00	29.19	6.558	5.999	2.047
23	0.0163	83.00	29.01	2.973	3.215	2.551
24	0.0130	90.00	29.08	4.079	1.953	1.756
25	0.0094	85.00	29.12	2.857	1.033	3.282
26	0.0092	93.00	29.05	4.395	3.987	2.281
27	0.0118	79.00	29.29	1.796	0.579	1.383
28	0.0102	90.00	29.14	2.155	0.927	2.726

* Pounds water per pound of air.

** Inches of mercury.

fit a hyperplane to the emissions to ascertain if there are any linear trends in pollutant levels as a function of ambient conditions.

If X_1, X_2 and X_3 denote the ambient variables and Y denotes one of the pollutant mass quantities (CO, HC or NOX computed as total over the LTO cycle), one can write

$$Y = b_0 + b_1 X_1 + b_2 X_2 + b_3 X_3$$

as an empirical relation. The coefficients b_0, b_1, b_2 and b_3 are constants determined from the data by least-squares analysis.

The following regression equations were obtained for CO, HC and NOX total mass over the LTO cycle.

For CO,

$$Y = 179.448 + 158.207 X_1 - 0.0565 X_2 - 5.940 X_3$$

For HC,

$$Y = 265.460 - 22.782 X_1 - 0.149 X_2 - 8.572 X_3$$

For NOX,

$$Y = 46.537 - 119.219 X_1 - 0.0143 X_2 - 1.426 X_3$$

where X_1 = specific humidity (lbs. H_2O/lb. air)

X_2 = inlet air temperature (°F)

and X_3 = atmospheric pressure (in.Hg.)

To determine whether the apparent trends with ambient conditions are statistically significant, one can employ analysis-of-variance principles. First, we consider the total sum of squares for the pollutant masses observed for each of the engines in the set. Next, we consider only the sum of squares of the differences observed when the mass for each engine is subtracted from the average for all engines. This sum of squares is considerably less than the sum of squares for the original data; the amount of the decrease can be identified as the sum of squares due to adjustment for the mean. Now let us suppose that the pollutant mass for each engine is computed by means of the appropriate regression equation. The difference between the value computed from the regression equation and the value originally observed can be considered as error, and the sum of squares of these errors can be computed. This error sum of squares, however, is less than the corresponding error sum of squares as calculated by adjustment for the mean only. The extent of the reduction can be identified as the sum of squares due to adjustment for the combined trends with specific humidity, inlet air temperature and atmospheric pressure.*

These considerations of sources of variability in results are summarized in Table 12. An F-ratio can be computed as the ratio of the mean squares due to b_1, b_2 and b_3 to the error mean squares. This F-ratio fails to reach even the 0.05 level of significance for CO, HC and NOX. Thus it must be concluded that the effects of ambient conditions on emissions are too small to be detected with the small amount of homogeneous data available. Note that significance is not reached even though the combined effects of humidity, temperature and pressure are considered; consequently, it is not possible to establish significance for the effect of any one of the ambient environmental parameters.

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* The quantity b'_o in Table 12 is actually the mean for the 11 engines and is different from b_o in the regression equation. Though the two quantities fulfill a similar role, that of a constant in an empirical equation, they will be equal only if the values of the variables X_1, X_2, and X_3 constitute an orthogonal set of vectors in the matrix formulation of the least-squares normal equations.

TABLE 12

ANALYSIS OF VARIANCE FOR EFFECTS OF AMBIENT CONDITIONS

Source of Variance	Degrees of Freedom	Sum of Squares	Mean Squares	F Ratio
CO MASS TOTAL OVER LTO CYCLE				
Total	11	148.5069		
Due to b_o, b_1, b_2, b_3	4	134.7413		
Due to b_o'	1	125.8265		
Due to b_1, b_2, b_3 (adj)	3	8.9148	2.9716	1.51
Error	7	13.7656	1.9665	
HC MASS TOTAL OVER LTO CYCLE				
Total	11	119.5071		
Due to b_o, b_1, b_2, b_3	4	99.8225		
Due to b_o	1	86.5649		
Due to b_1, b_2, b_3 (adj)	3	13.2576	4.4192	1.57
Error	7	19.6846	2.8121	
NOX MASS TOTAL OVER LTO CYCLE				
Total	11	58.0593		
Due to b_o, b_1, b_2, b_3	4	55.3588		
Due to b_o	1	54.7069		
Due to b_1, b_2, b_3 (adj)	3	0.6519	0.2173	0.56
Error	7	2.7005	0.3858	

4. SUMMARY AND CONCLUSIONS

Aircraft engine exhaust emissions data compiled under this program as a baseline for promulgation of emission standards also has potential to provide important insights with regard to factors affecting emissions. Because of the range of circumstances under which the numerous tests were performed, however, the use of the data for the latter purpose is restricted in its applicability. Factors which might be presumed to affect emissions, such as engine age and ambient conditions, are often confounded in such a way that the isolation of their individual contributions is not practicable. In order to separate these effects definitively, experiments designed more specifically for this purpose, with due regard to disturbing sources of error, would be required.

Mass emissions, as quantified in this program, are based on a specific landing - takeoff cycle. In the case of CO and HC emissions, the mass emissions over the LTO cycle are strongly dominated by the taxi-idle mode of operation, and it is this mode which is most subject to variability in the observed and estimated mass emissions. The standard deviation of total CO mass emissions over the LTO cycle, as determined from the available data base, is estimated as approximately 30% of the average CO mass emission. The corresponding estimate for HC is approximately 45% of the average HC mass emission for the LTO cycle. In general, NOX emissions measurements are more repeatable; the standard deviation of NOX mass emissions for the LTO cycle is approximately 15% of the average mass emission for the cycle.

The variability observed in exhaust emissions measurements prescribes that a relatively large number of tests must be conducted in order to estimate the average mass emission levels for a particular engine model. Specifically, it is estimated that to have 95% confidence that the average is known to within 10% of its true value, as many as 36 tests may be required for CO and 81 tests for HC. Similarly, in order to establish that an observed difference in mass emissions for two series of tests in statistically significant, the actual difference must be quite large or a large number of observations must be available. This fact made it difficult to assess the influence of such factors as engine age, specific humidity, temperature and atmospheric pressure on mass emissions.

In summary, the following statements can be made with regard to aircraft engine exhaust emissions as determined in this analysis.

1. Variation in total mass emissions over the LTO cycle, as measured by the standard deviation of tests performed on several engines of the same model, often approaches the magnitude of the average for all engines in the set. Replicate tests on a particular engine may be subject to as much variation as that attributable to engine-to-engine variability.

2. Unless a sufficient number of engines of a particular model are tested, the average mass emissions for that model, as well as the range of values for individual engines in that category, is subject to considerable uncertainty. Much of the uncertainty in the case of CO and HC stems from the critical role played by the taxi-idle mode of operation.

3. Lack of repeatability of engine exhaust emissions measurements stems partly from experimental and measurement errors and partly from differences in performance of individual engines. If measurement errors dominate, several replicate tests on a few engines is more effective in increasing precision than is an equal total number of tests allocated to a larger number of engines without replicate measurements. If engine-to-engine variability dominates experimental error, the reverse strategy would be preferred.

4. In some cases, significant differences were observed in the mass emissions reported by different test organization for the same category of engines. Because of the possible confounding of causes responsible for these differences, their occurrences poses a problem in how to use the data from the several sources in the most effective manner. The testing of a standard or "referee" engine by all testing organization is a conceivable scheme for eliminating such biases and unifying test results.

5. Time since overhaul of the hot section did not appear to have a statistically significant effect on CO and HC emissions, as determined by the total mass emissions over the LTO cycle. Some indication of an effect of engine age on total NOX emissions over the cycle was observed.

6. Some evidence was adduced to indicate that NOX total mass emission over the LTO cycle may be higher for engines equipped with smokeless burner cans than for engines not so equipped.

7. No evidence was found to indicate that the ambient conditions of specific humidity, temperature and atmospheric pressure affect gaseous emissions of aircraft engines. Such effects, if present, are too small to be detectable within the statistical variation which characterizes the emissions measurements.

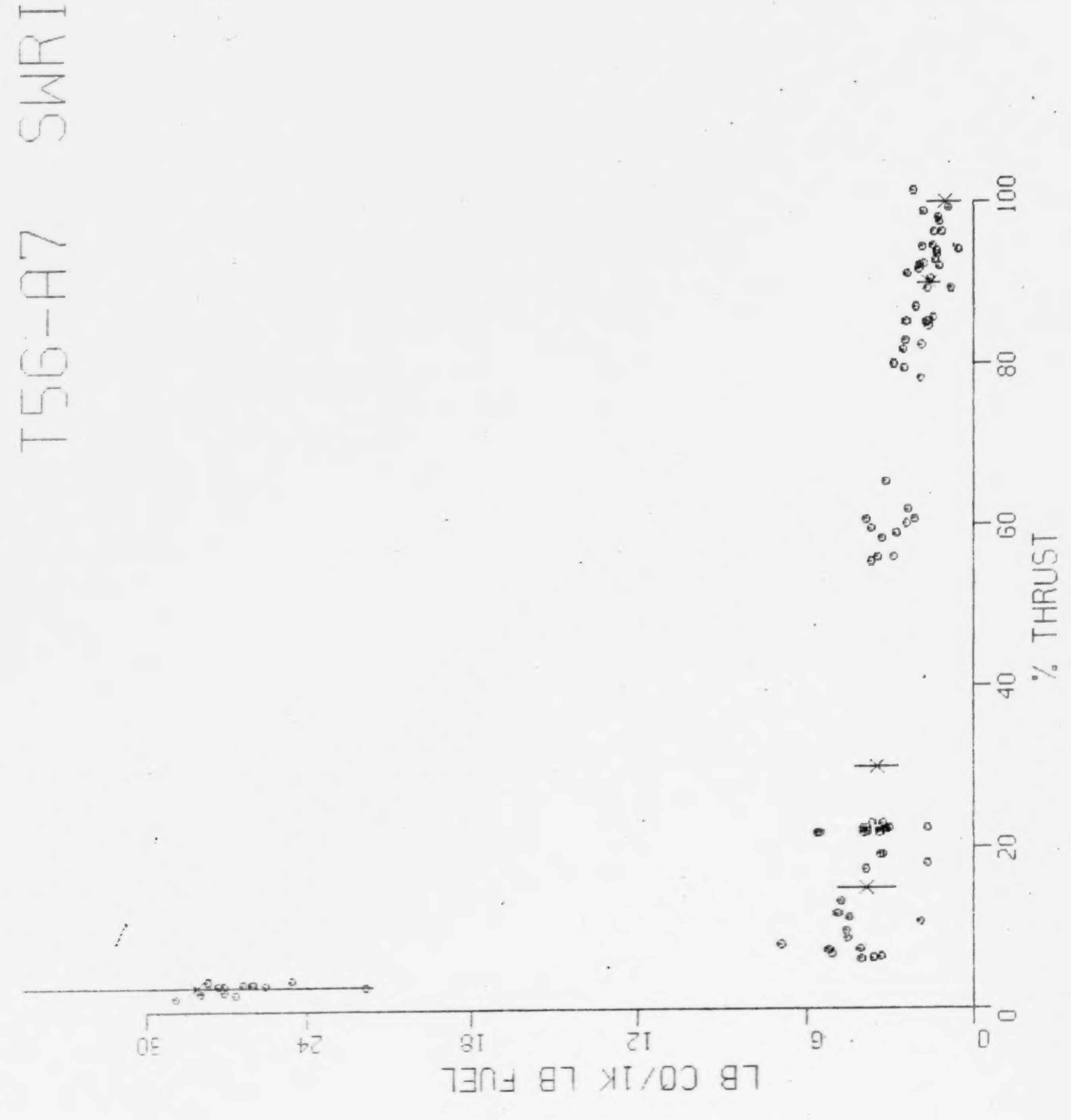
The above conclusions are necessarily generalized and might be termed "macro conclusions" in the sense that they are formulated from a broad overview of the extensive compilation of emissions data as a whole. This fact does not preclude the existence of specific or "micro conclusions" with regard to specific engine categories or other circumstances nor the fact that such conclusions may be contrary to the general conclusions drawn above. Further assessment of emissions results according to the specific interests of the reader must necessarily be performed on an individual basis but is facilitated by the statistical guidelines developed in this report.

APPENDIX I

COMPOSITE PLOTS OF AIRCRAFT ENGINE EXHAUST EMISSIONS

CONTENTS:

I-2 TO I-4	T56-A7 ENGINES – SWRI
I-5 TO I-7	T56-A15 ENGINES – ALLISON
I-8 TO I-10	TPE 331 ENGINES – AIRESEARCH
I-11 TO I-13	CJ-805-3A ENGINES – SWRI
I-14 TO I-16	JT3C ENGINES – UNITED
I-17 TO I-19	JT3C ENGINES – SWRI
I-20 TO I-22	JT3D ENGINES – PRATT & WHITNEY
I-23 TO I-25	JT3D EXPERIMENTAL – P & W
I-26 TO I-28	JT3D ENGINES – SWRI
I-29 TO I-31	JT3D ENGINES – UNITED
I-32 TO I-34	JT3D ENGINES – BU MINES
I-35 TO I-37	JT4A ENGINES – SWRI
I-38 TO I-40	JT8D UNDILUTED, SMOKELESS – SWRI
I-41 TO I-43	JT8D UNDILUTED, REGULAR – SWRI
I-44 TO I-46	JT8D DILUTED, SMOKELESS – BU MINES
I-47 TO I-49	JT8D DILUTED, REGULAR – BU MINES
I-50 TO I-52	JT8D DILUTED, SMOKELESS – P & W
I-53 TO I-55	JT8D EXPERIMENTAL – P & W
I-56 TO I-58	JT8D DILUTED, SMOKELESS – UNITED
I-59 TO I-61	JT8D DILUTED, REGULAR – UNITED
I-62 TO I-64	JT9D ENGINES – P & W
I-65 TO I-67	JT9D EXPERIMENTAL – P & W
I-68 TO I-70	SPEY 511 – BU MINES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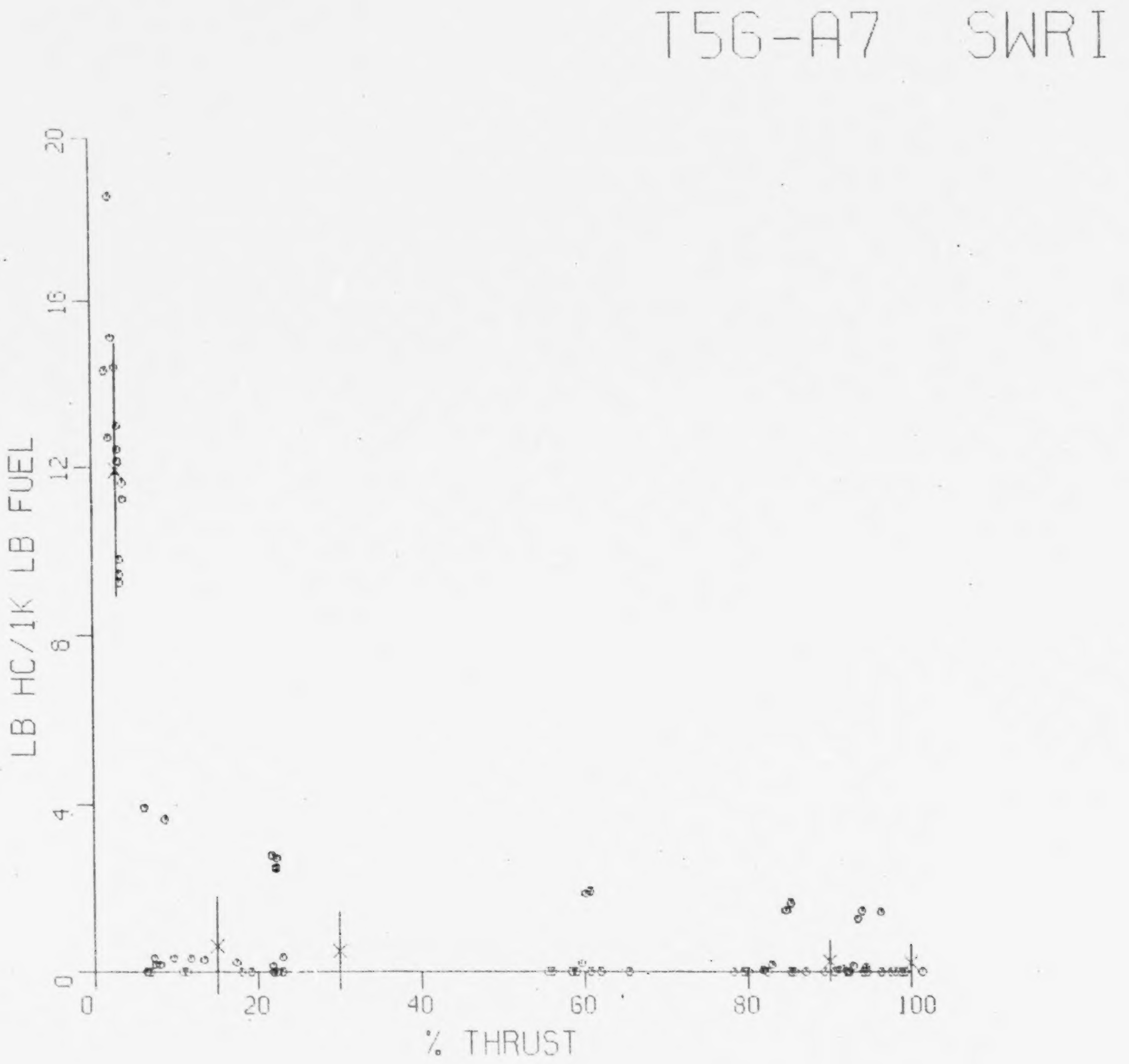
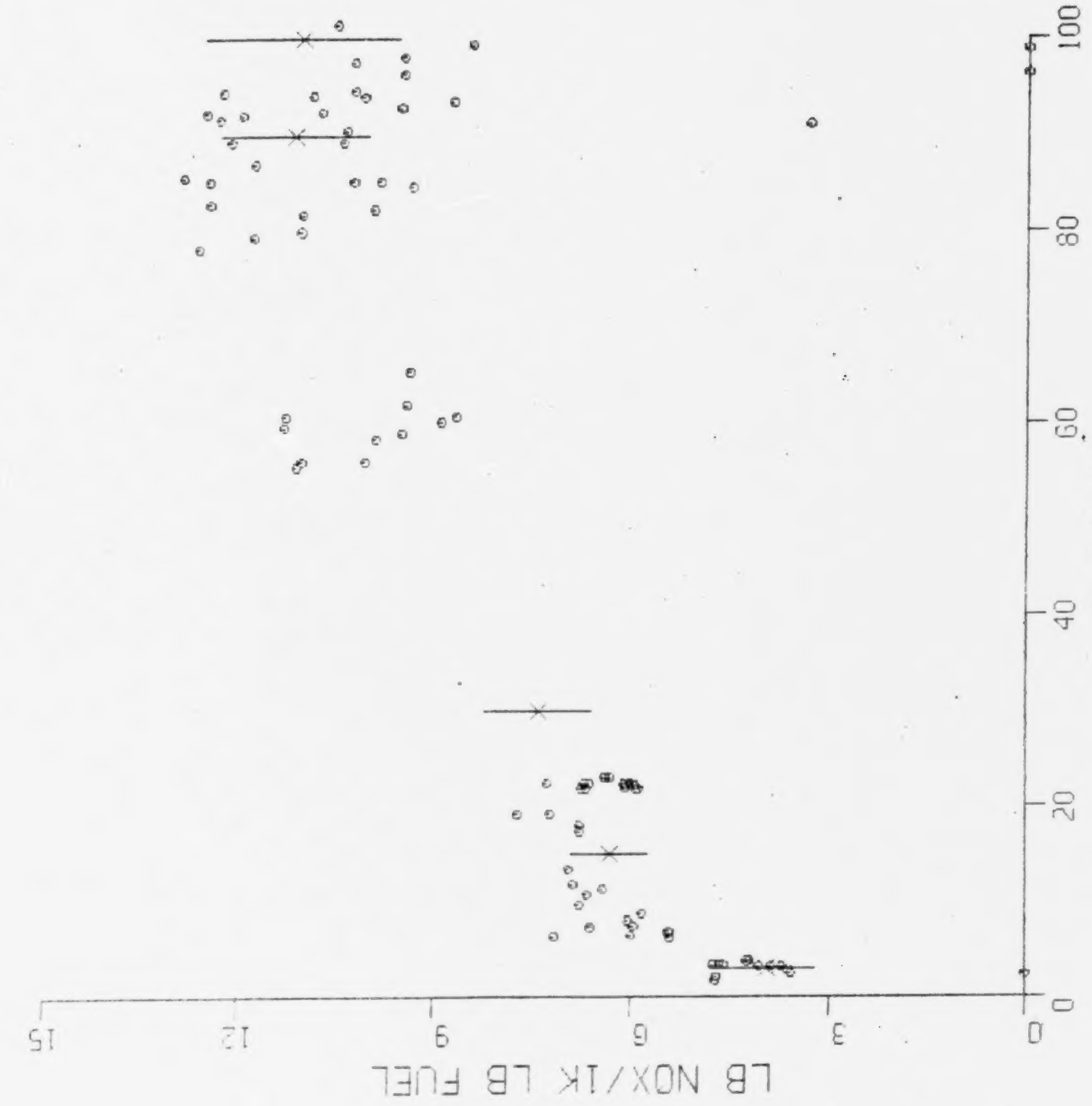
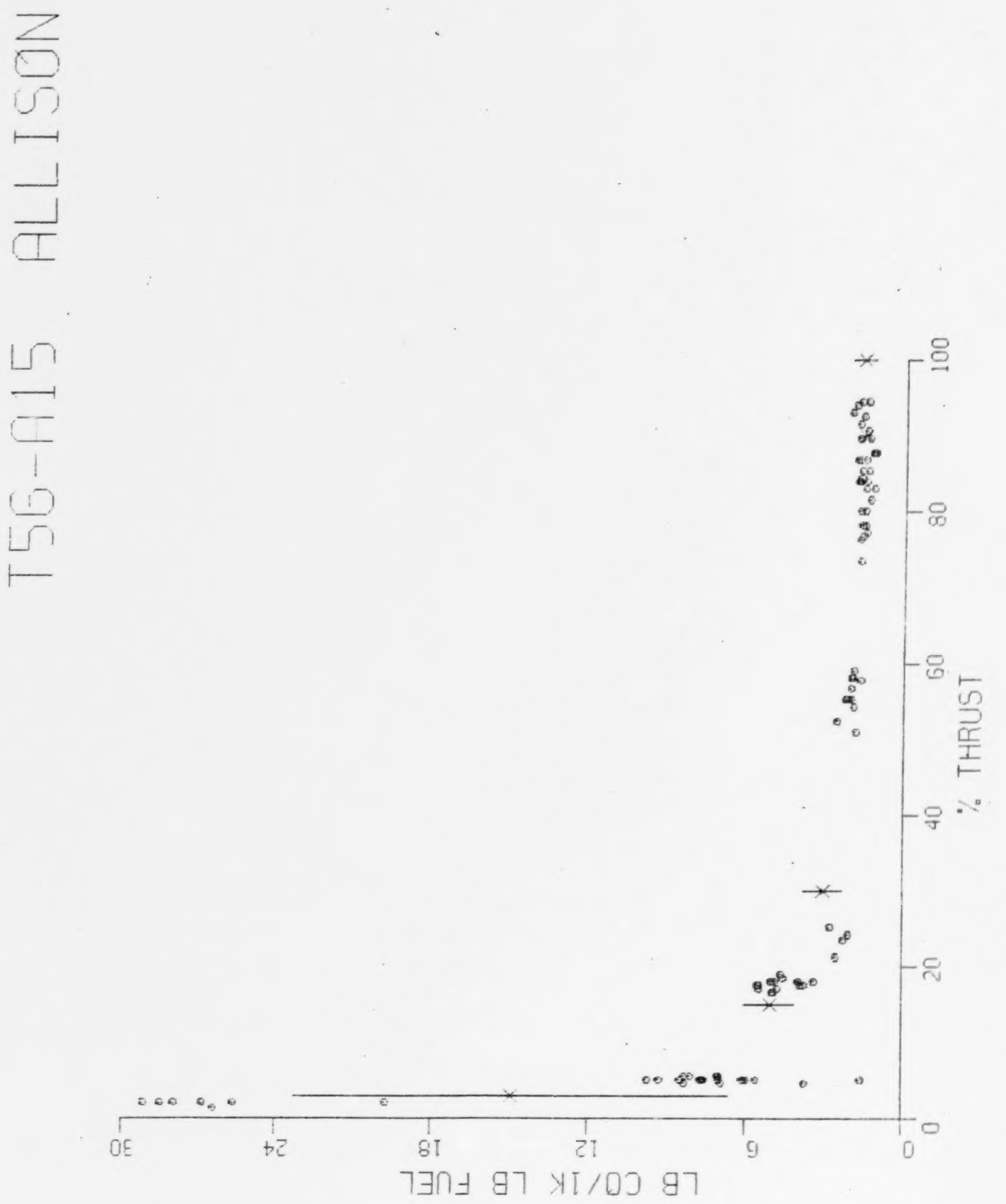
LB CO/1K LB FUEL
0
6
12
18
24
30
% THRUST
0
20
40
60
80
100

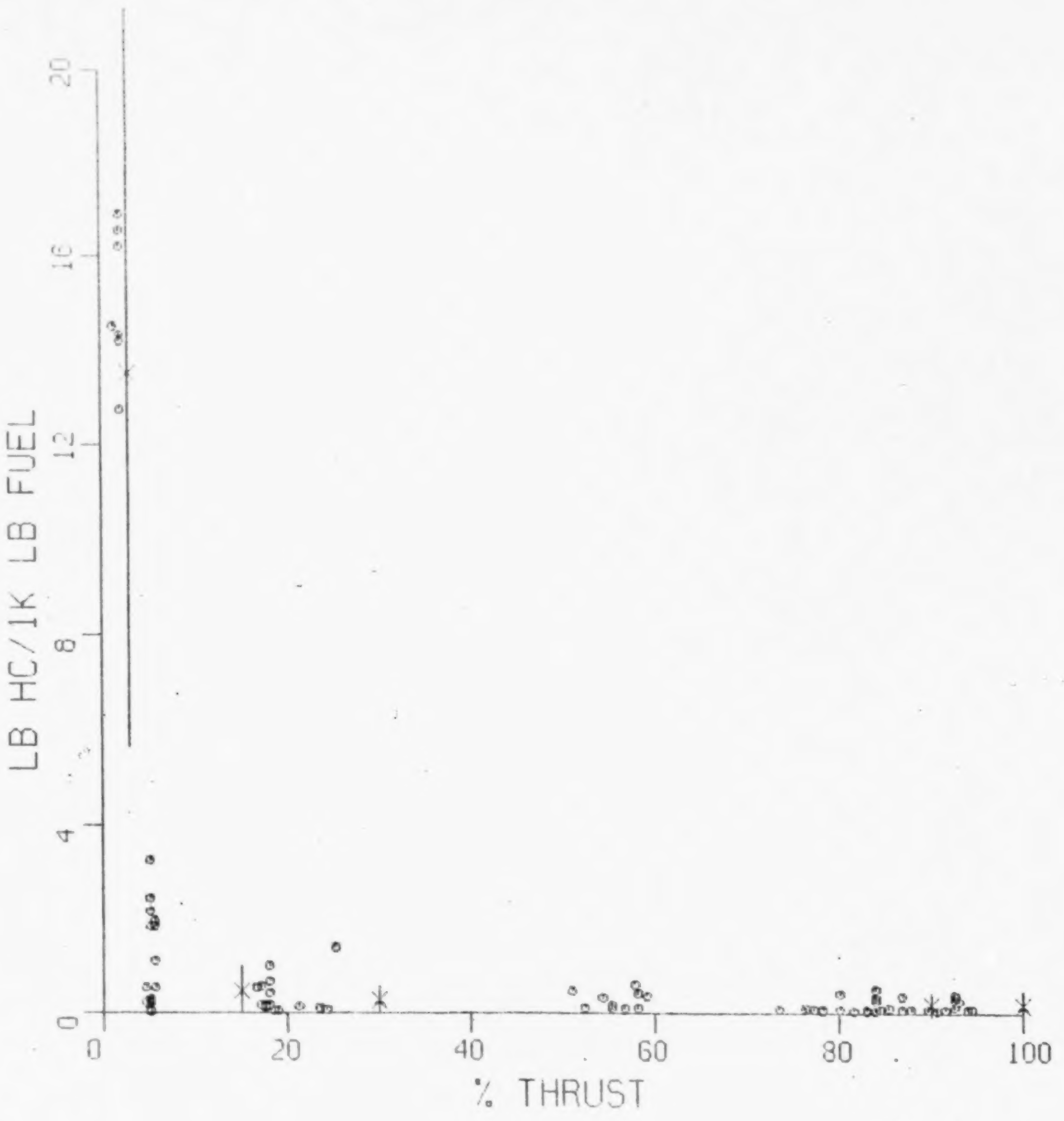

T56-A7 SWRI
LB HC/1K LB FUEL
20
16
12
8
4
0
0
20
40
60
80
100
% THRUST

T56-A7 SWRI

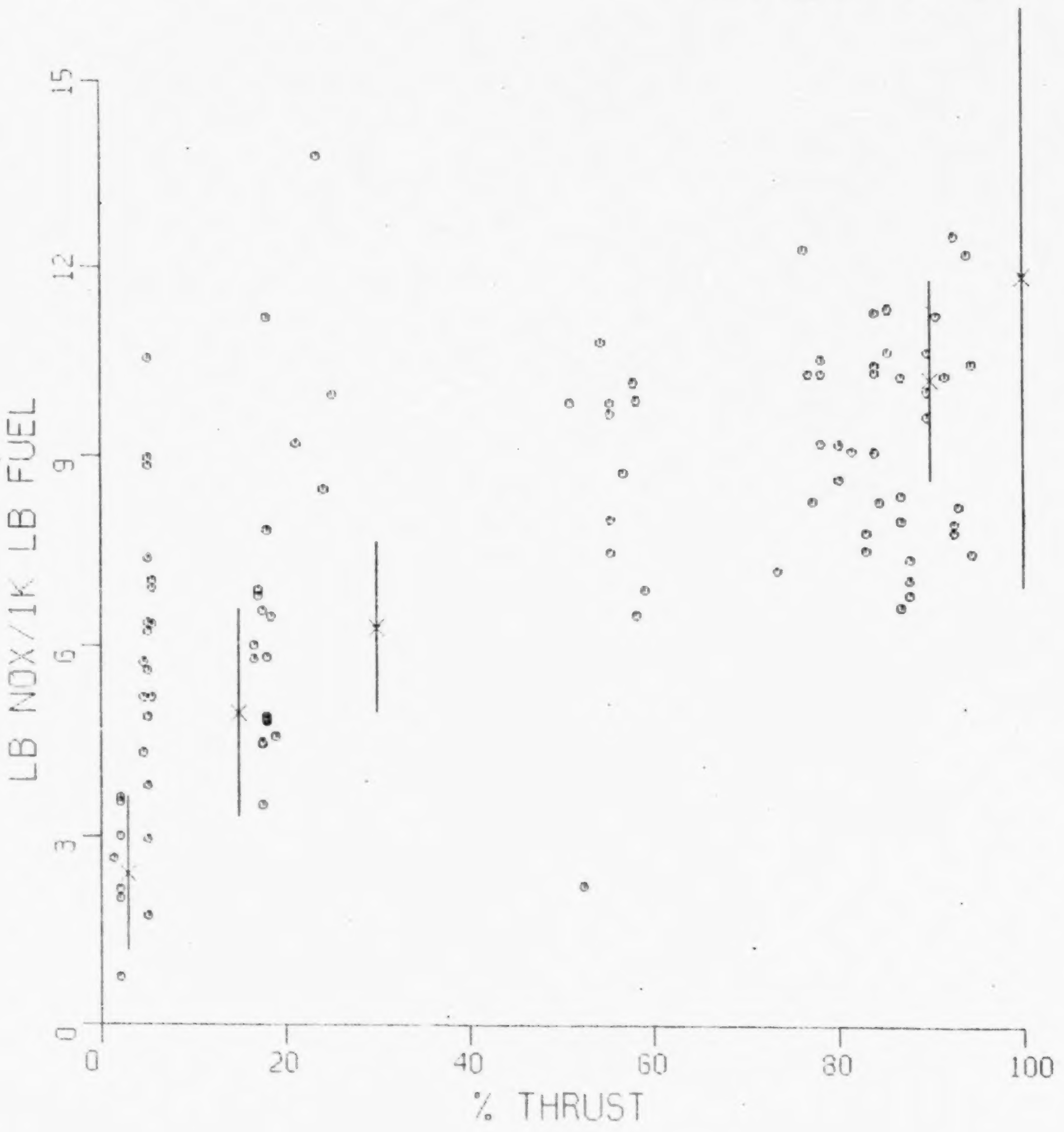



T56-A15 ALLISON
LB CO/1K LB FUEL
0
6
12
18
24
30
% THRUST
0
20
40
60
80
100

T56-A15 ALLISON



T56-A15 ALLISON



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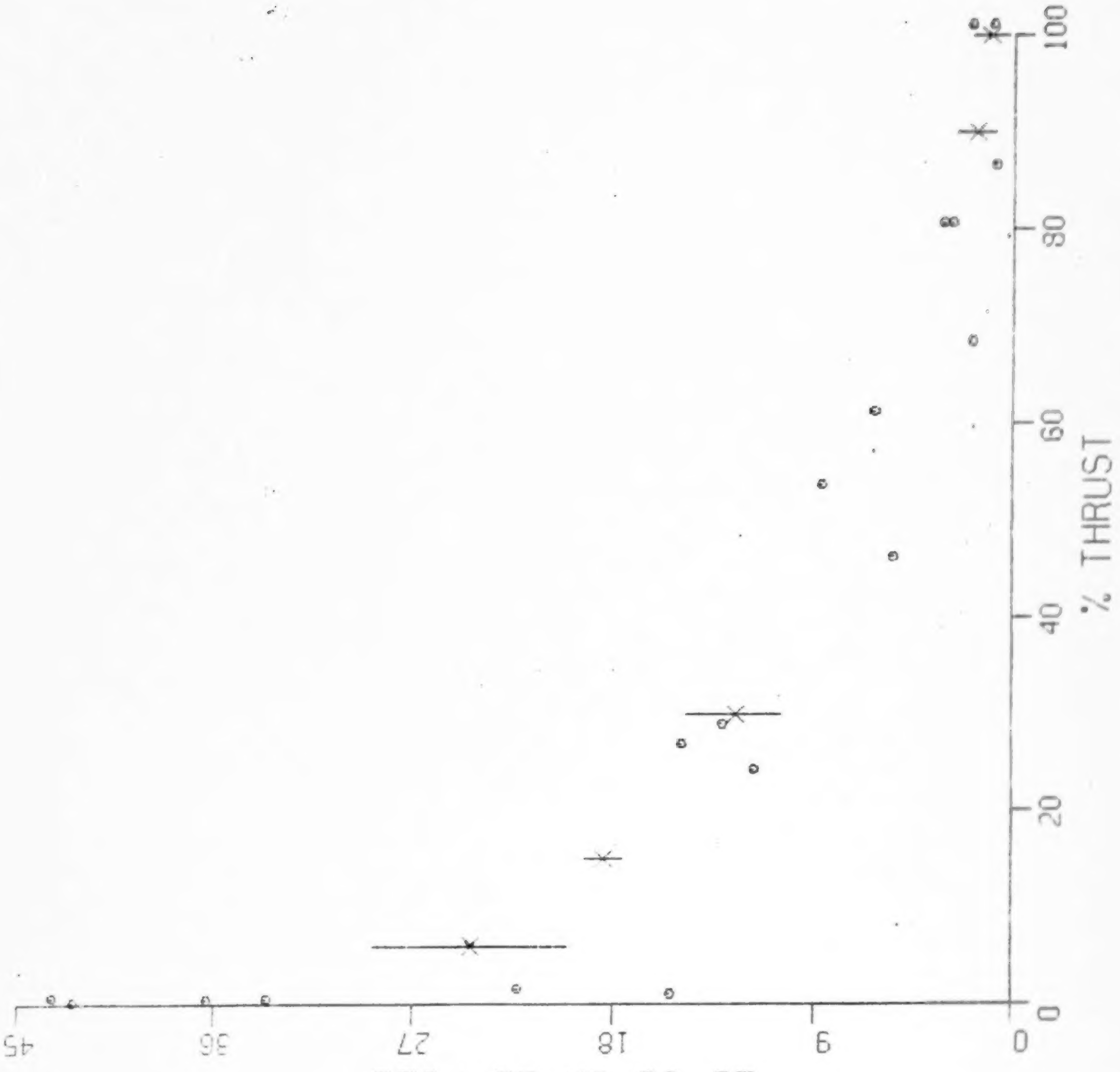

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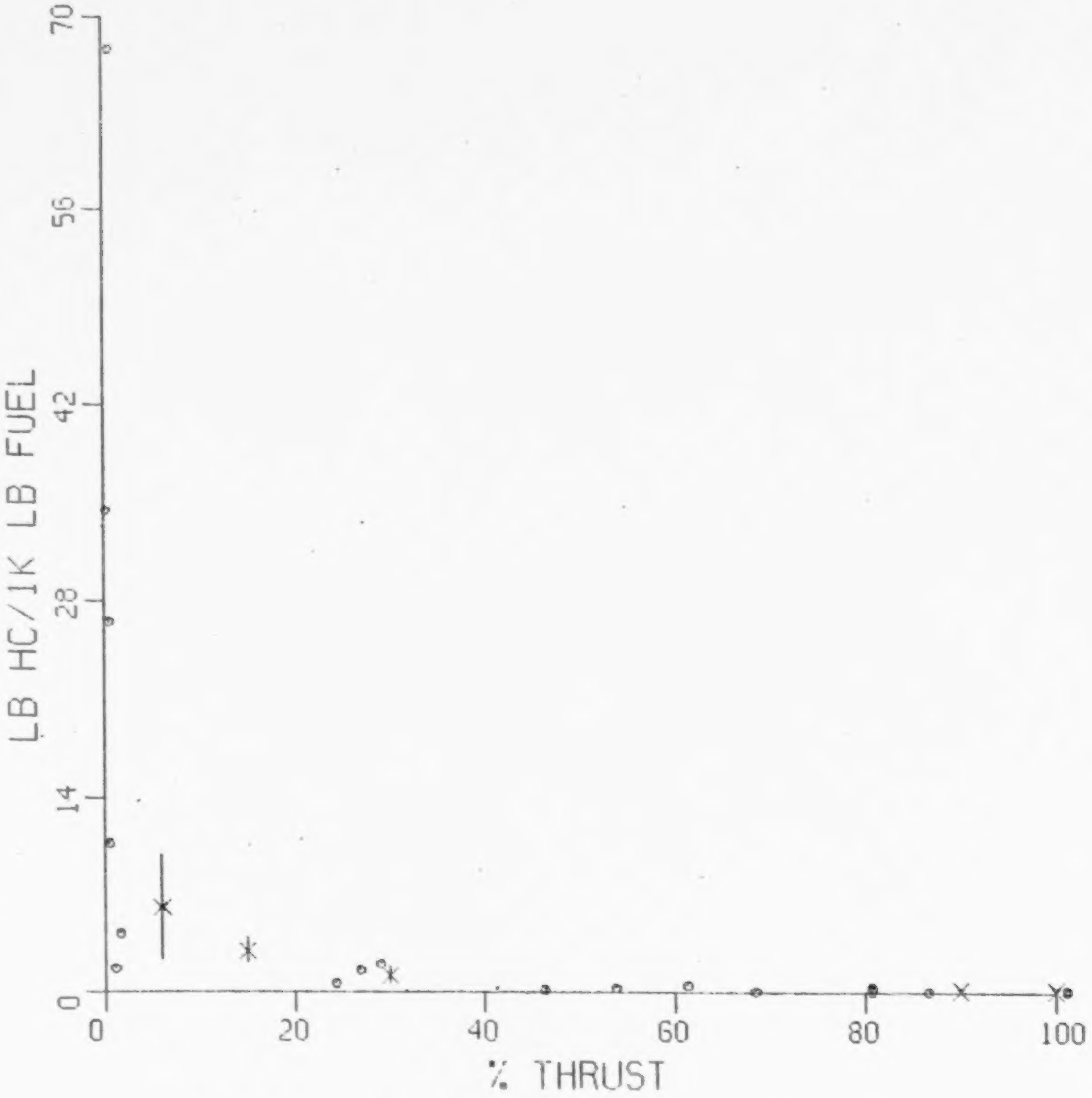

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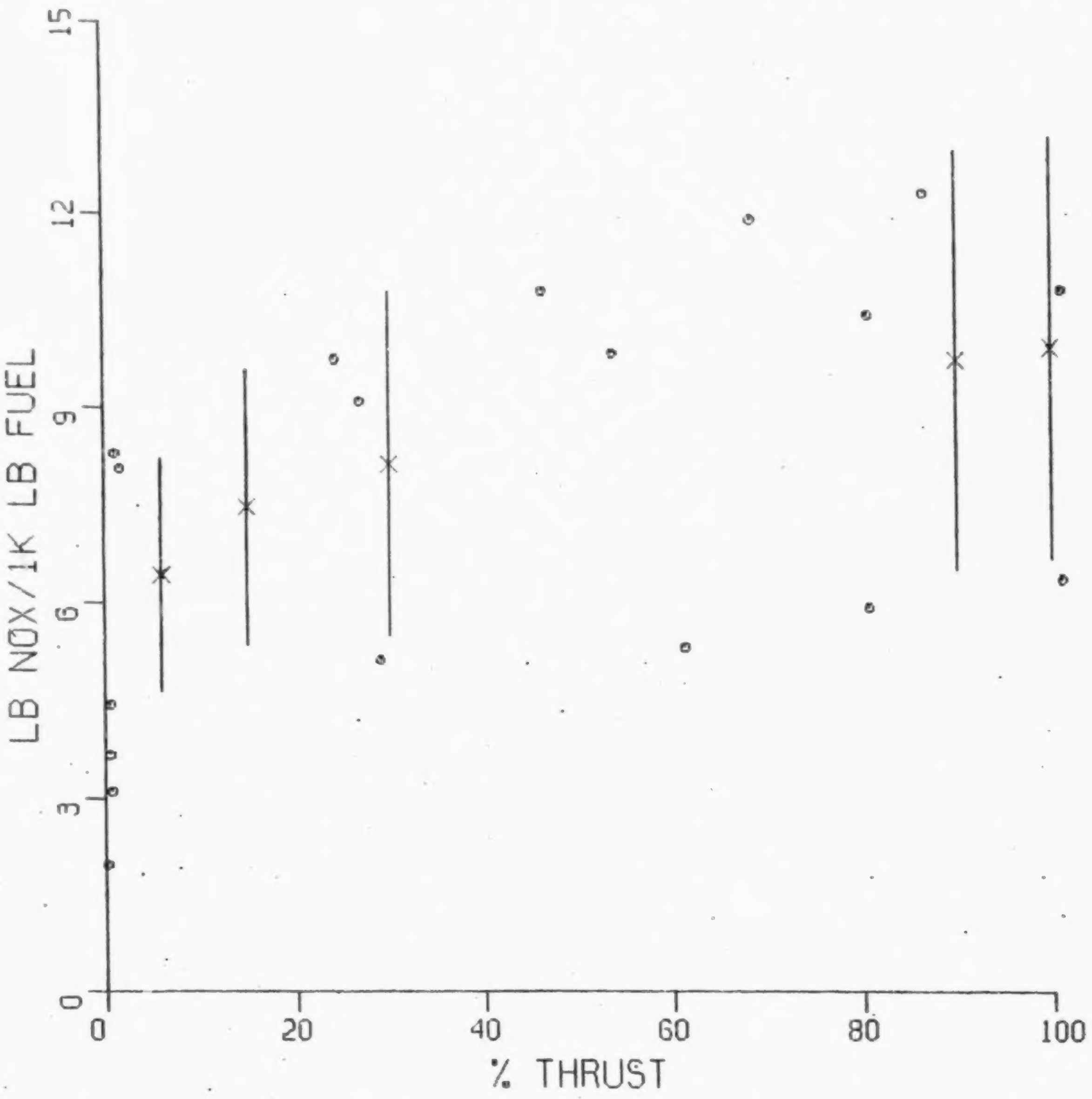

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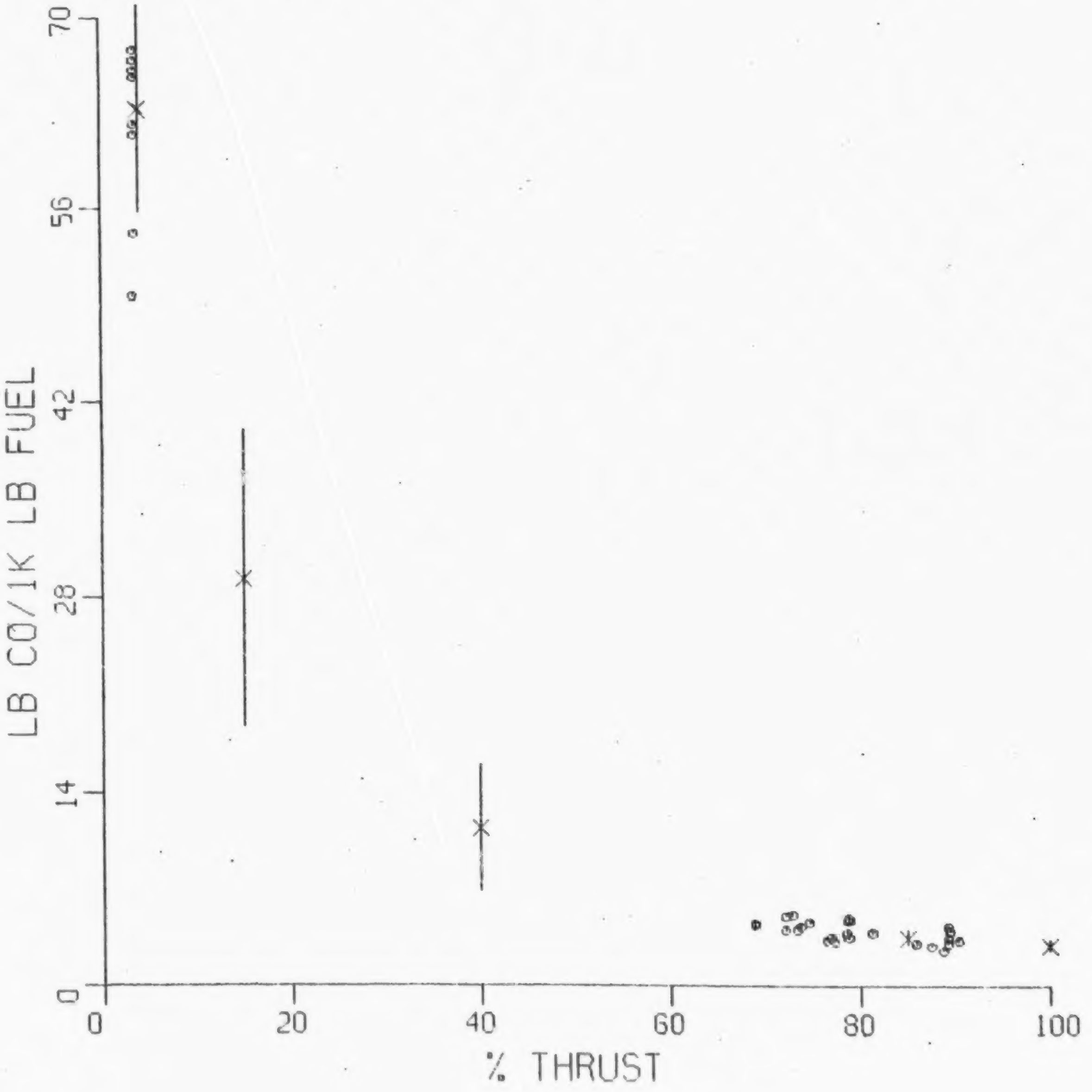

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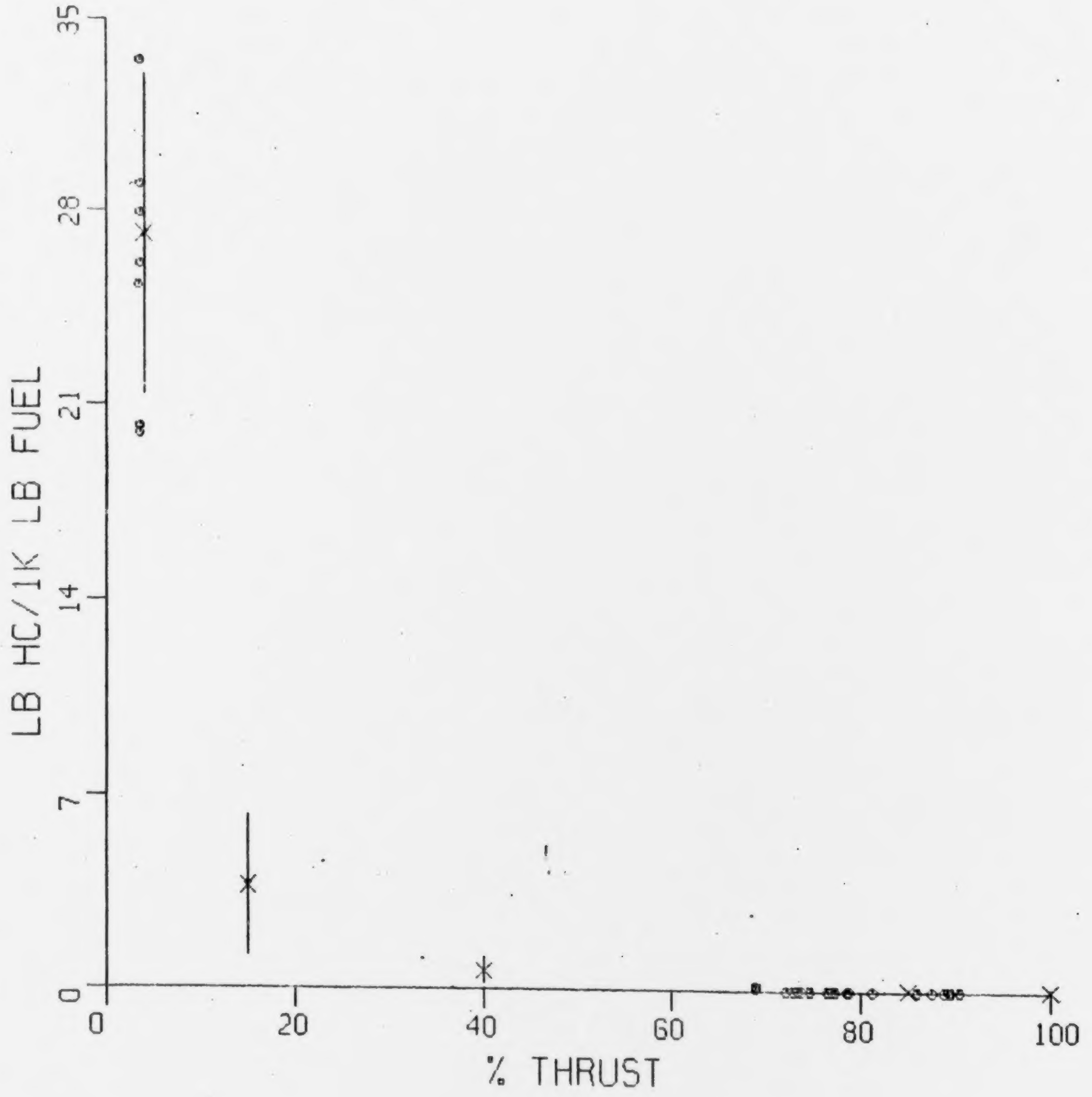
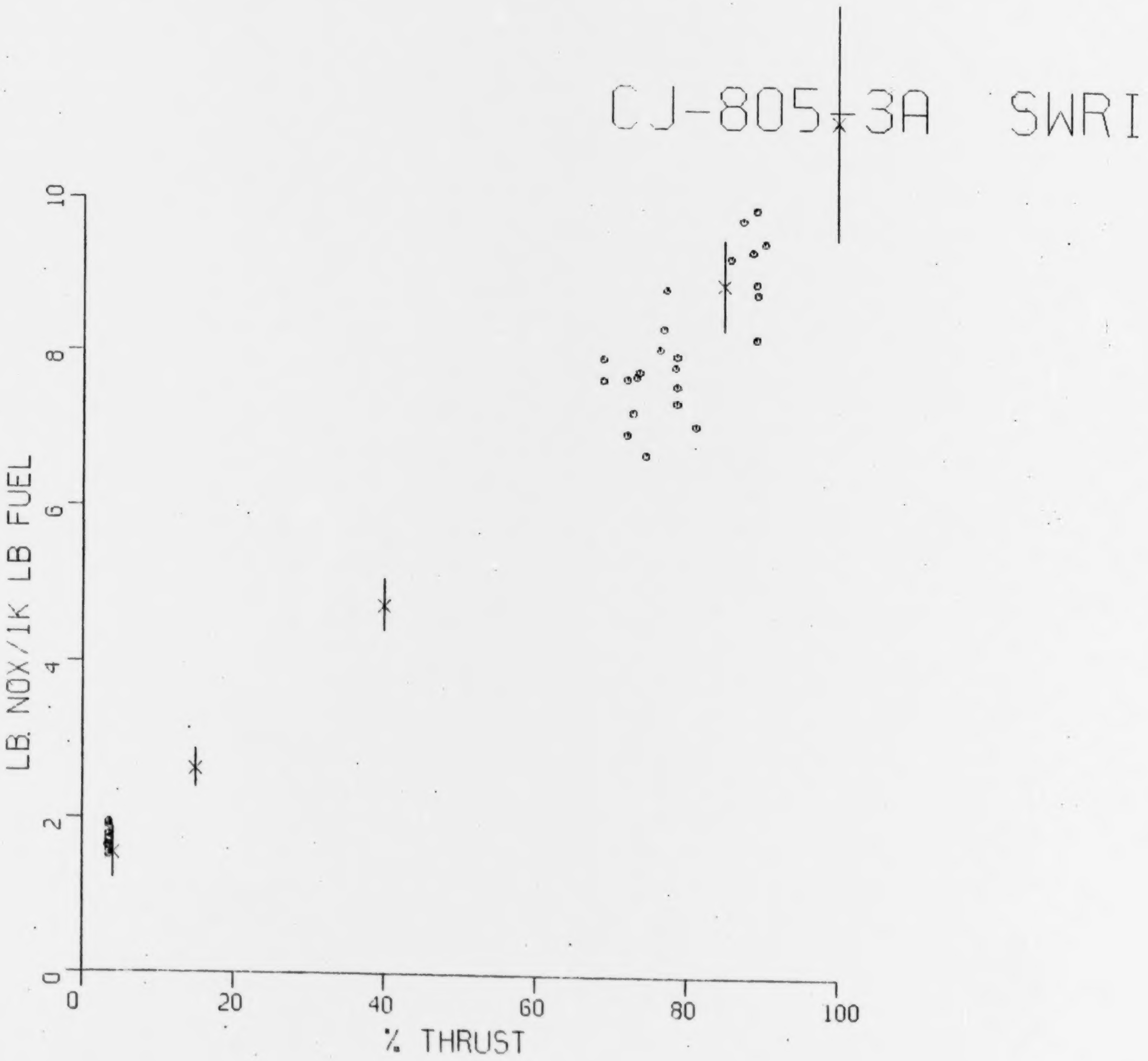
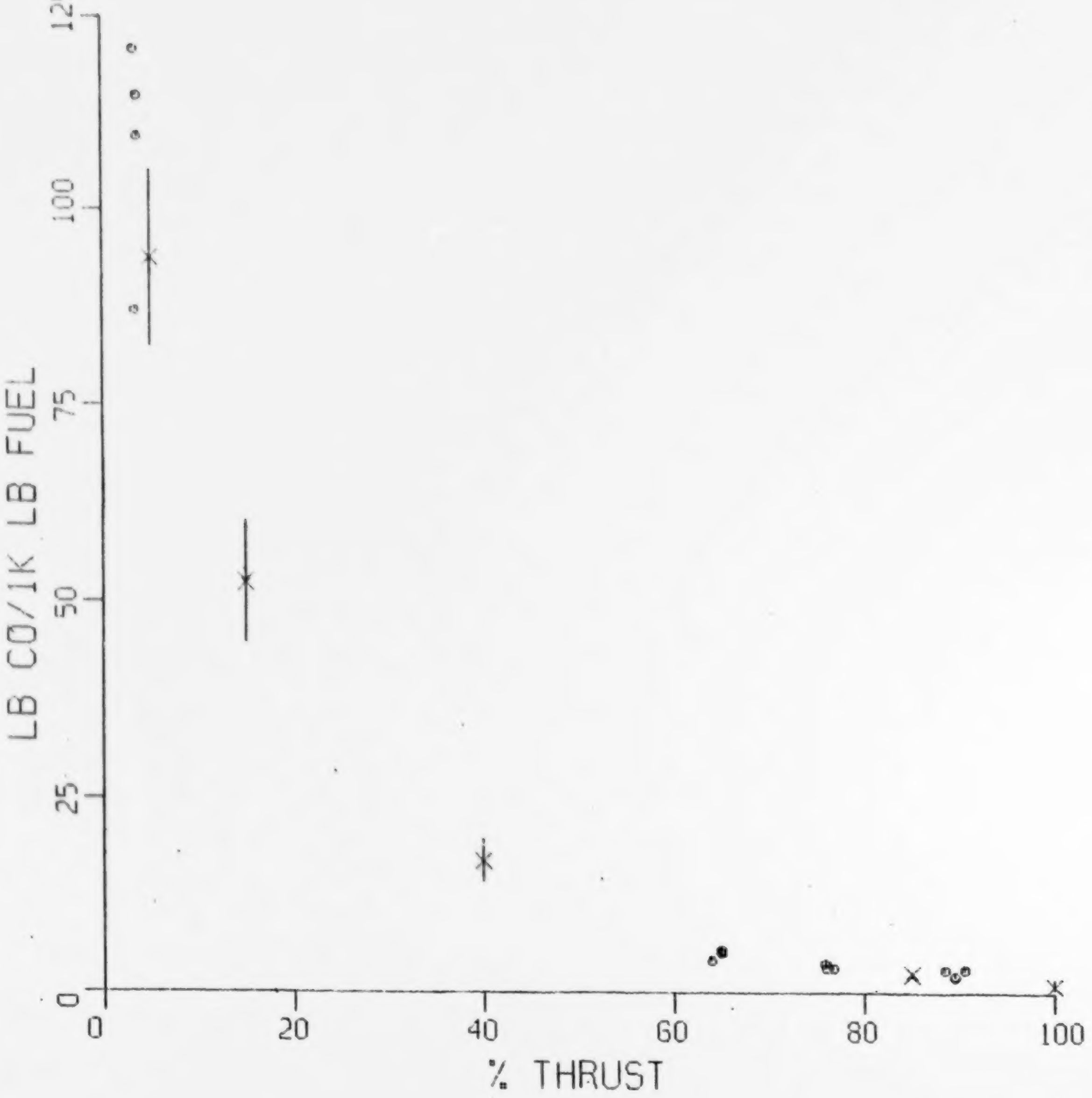
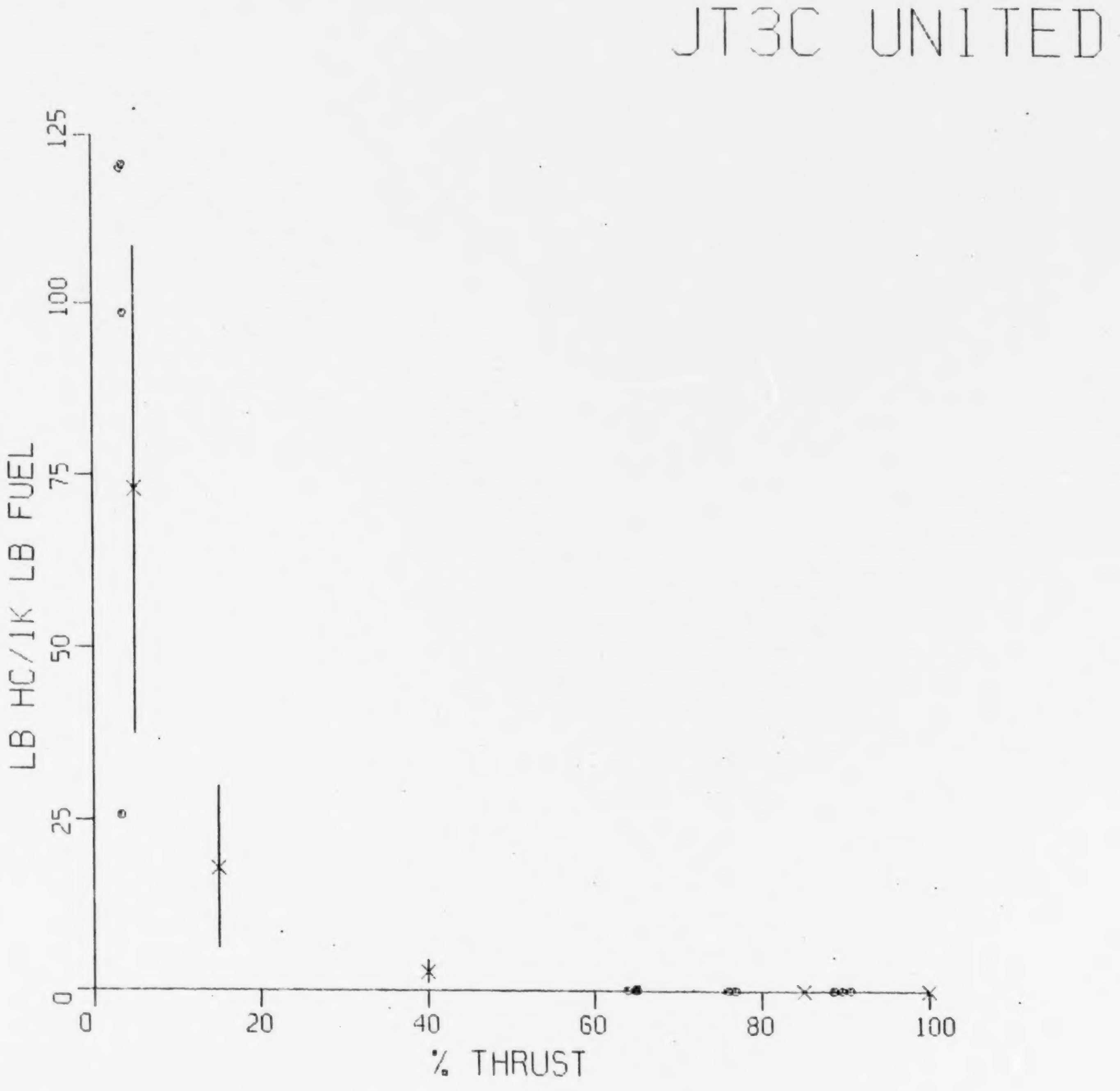



CJ-805-3A SWRI
LB. NOX/1K LB FUEL
0
2
4
6
8
10
% THRUST
0
20
40
60
80
100

JT3C UNITED

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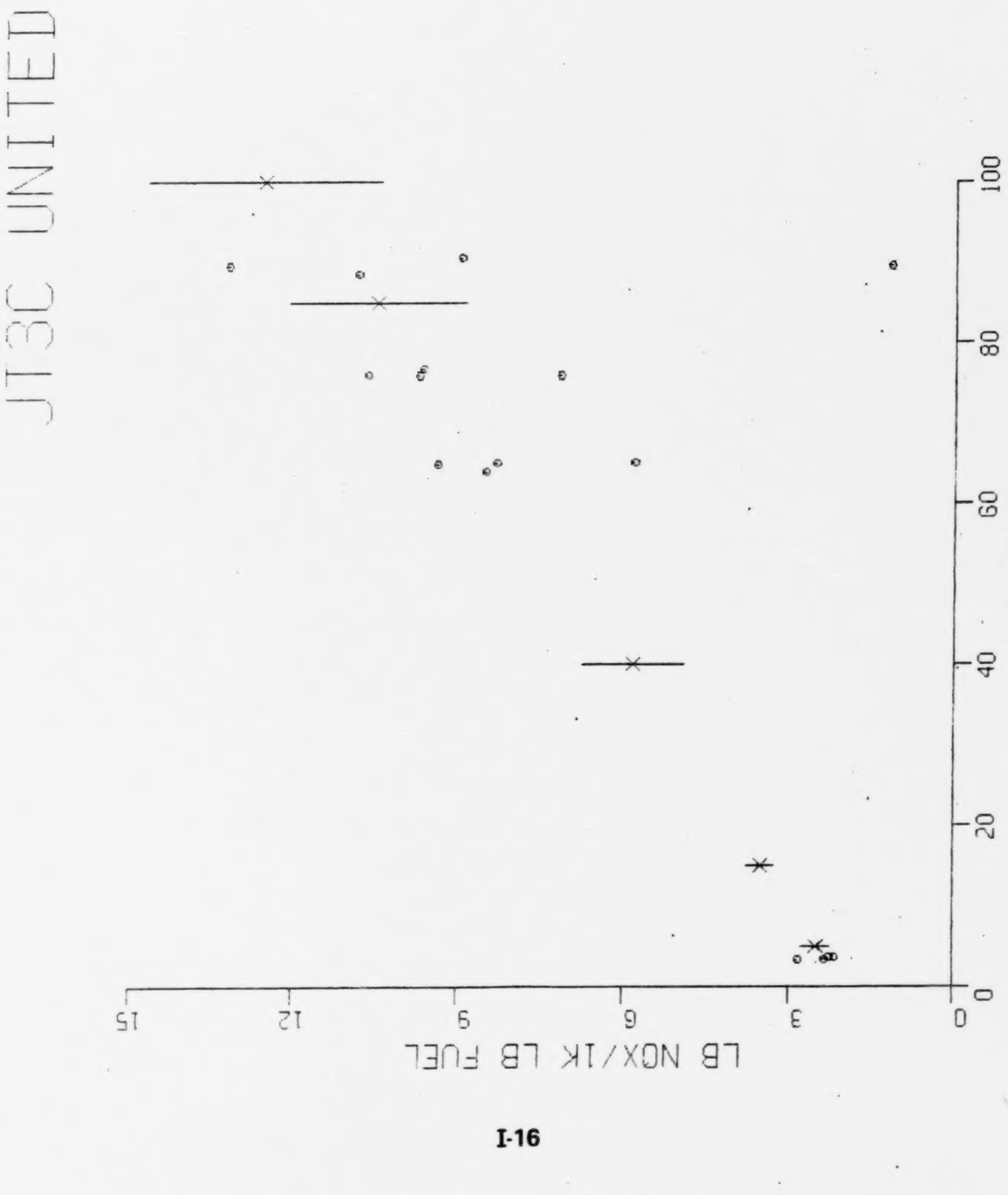
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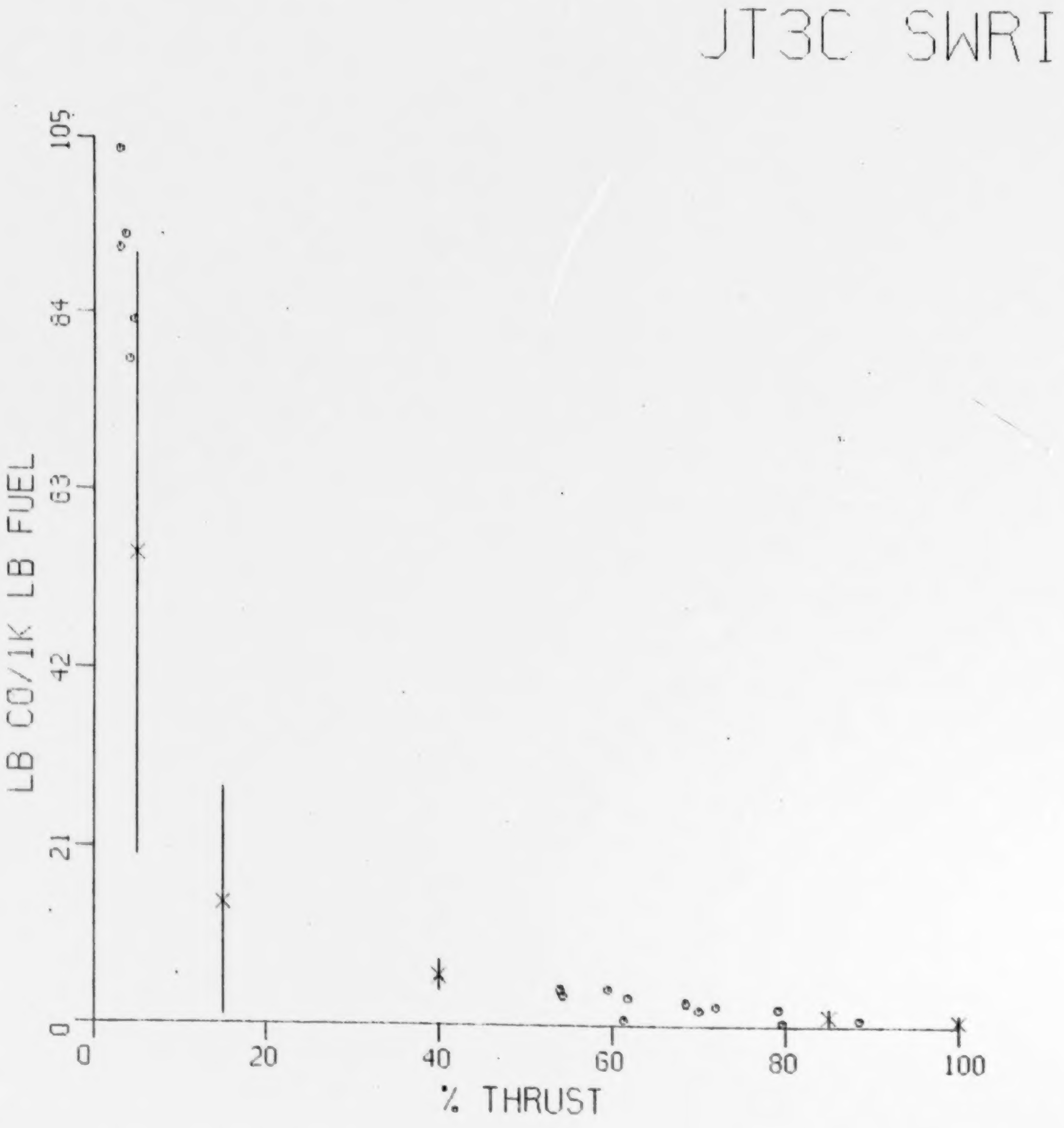
0
3
6
9
12
15
% THRUST
0
20
40
60
80
100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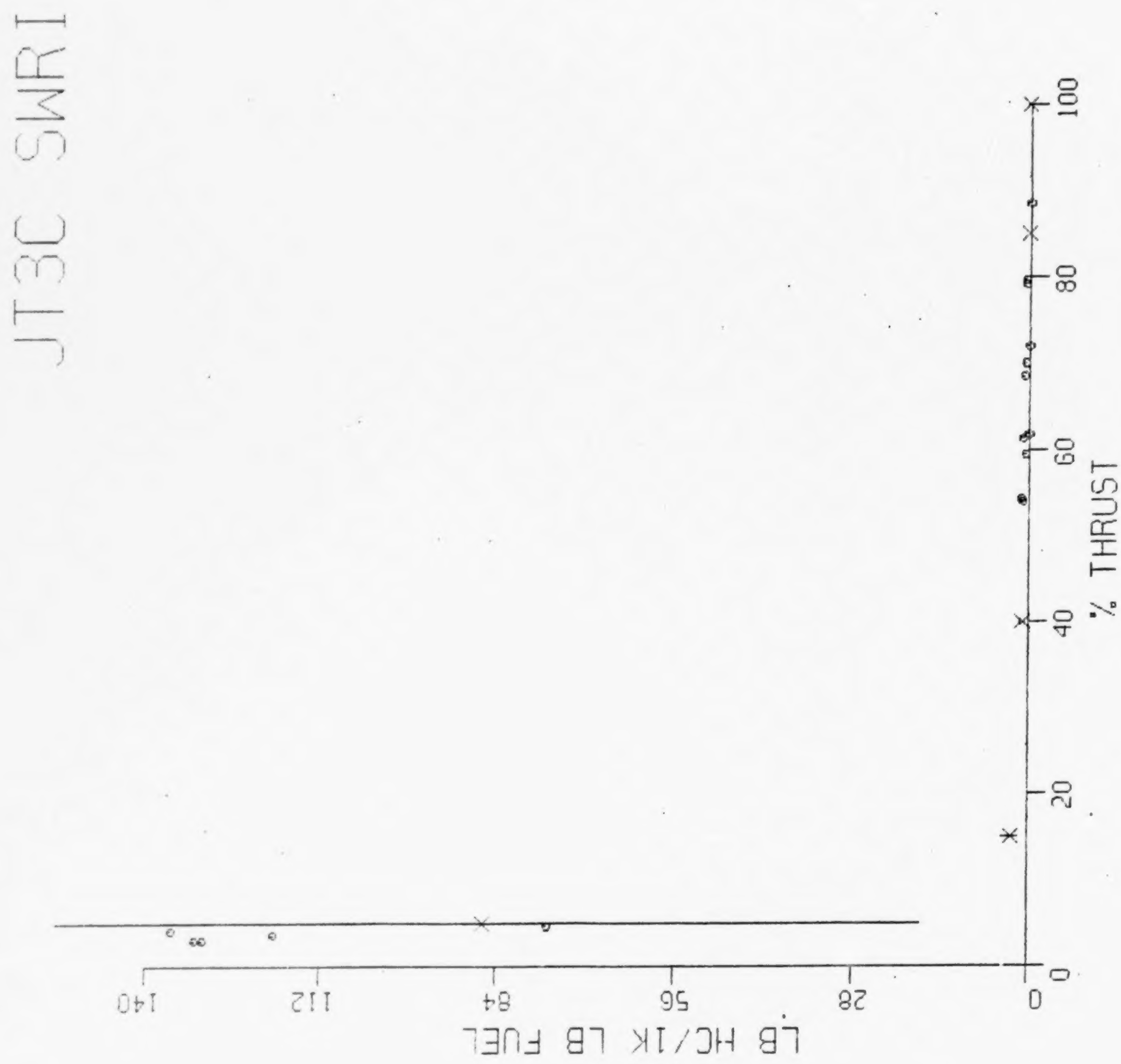
LB CO/1K LB FUEL
105
84
63
42
21
0
0
20
40
60
80
100
% THRUST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LB HC/1K LB FUEL
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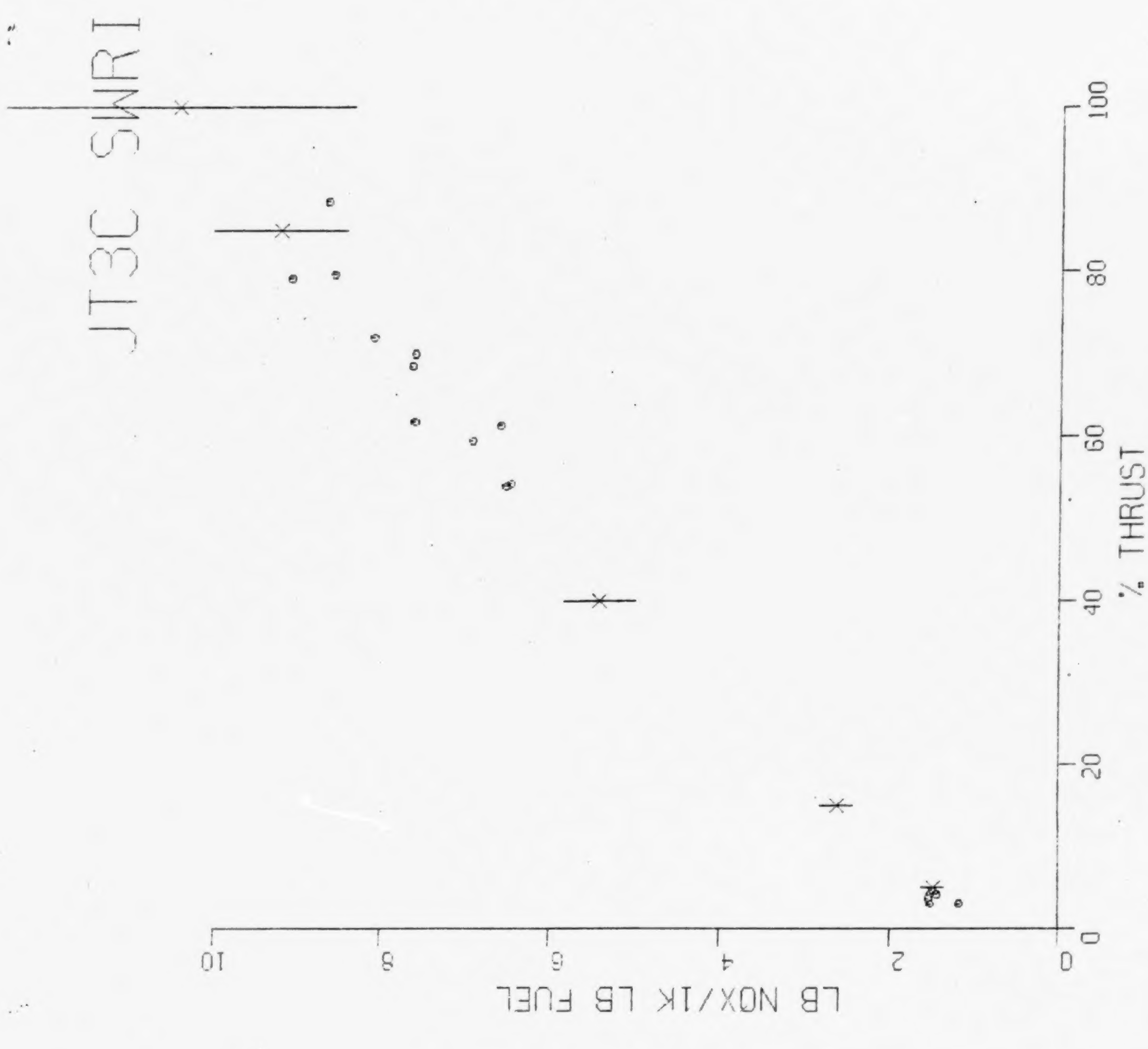
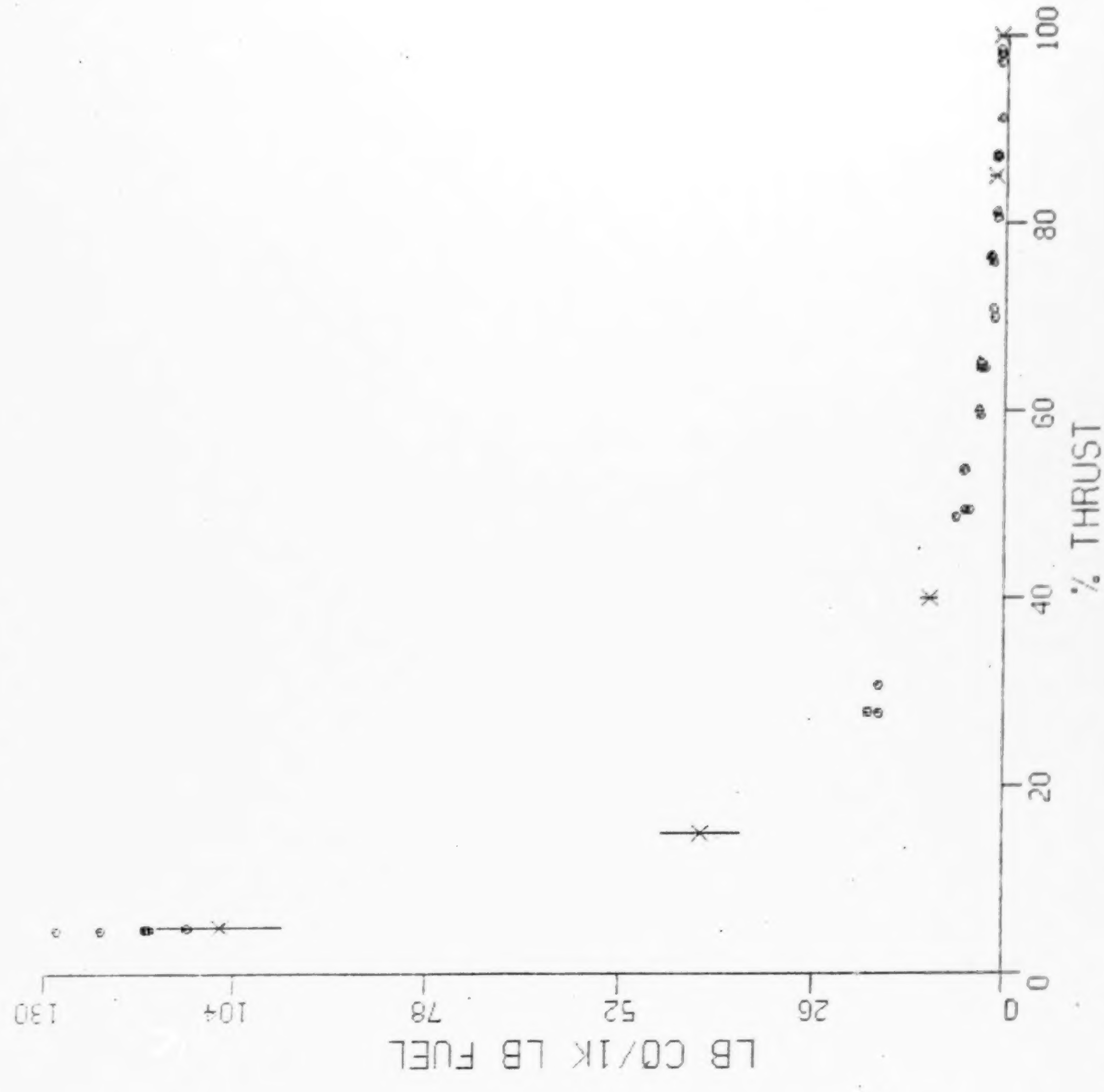
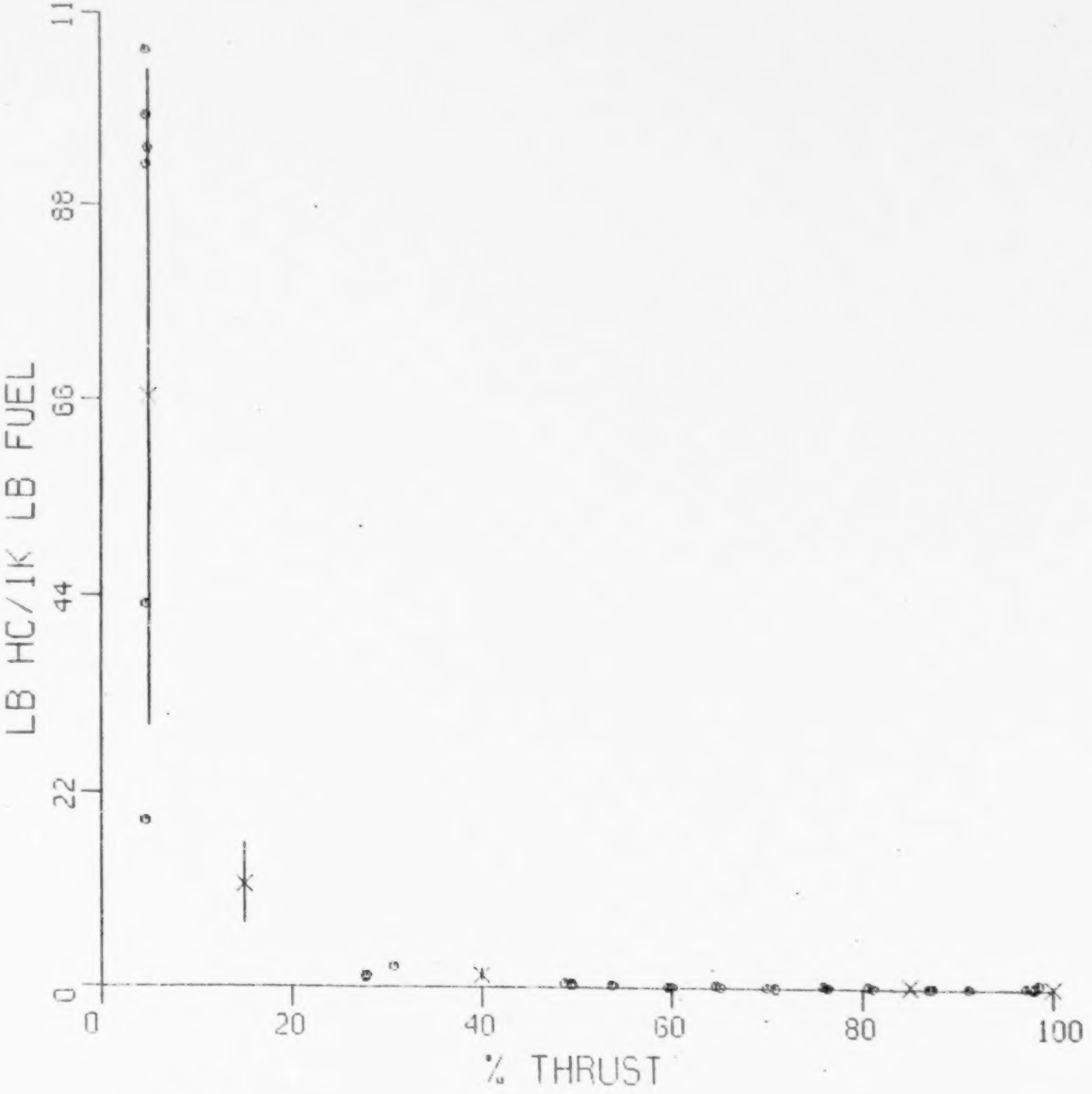
56
84
112
140
% THRUST
0
20
40
60
80
100

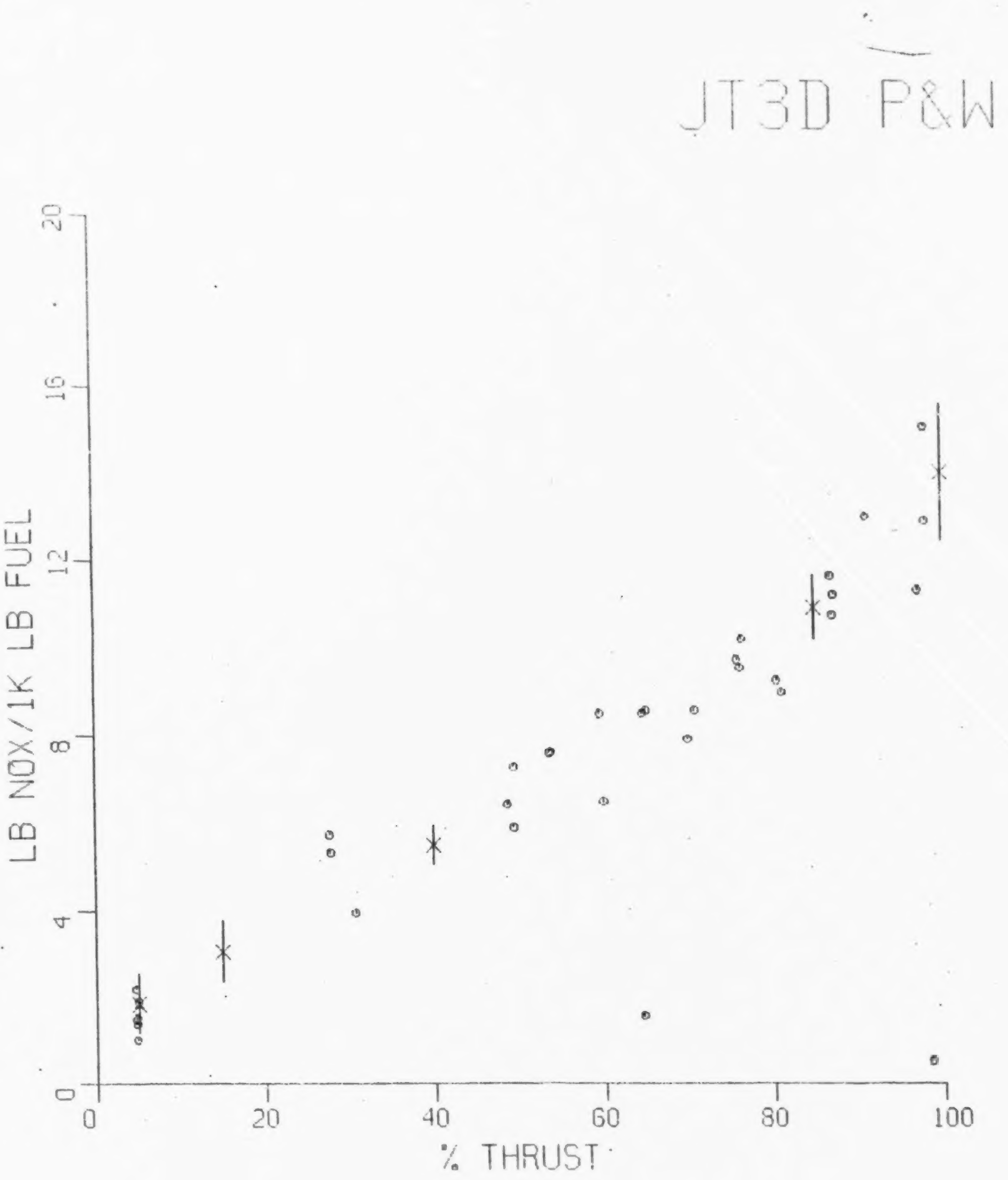

JT3C SWRI
LB NOX/1K LB FUEL
0
2
4
6
8
10
% THRUST
0
20
40
60
80
100

JT3D P&W

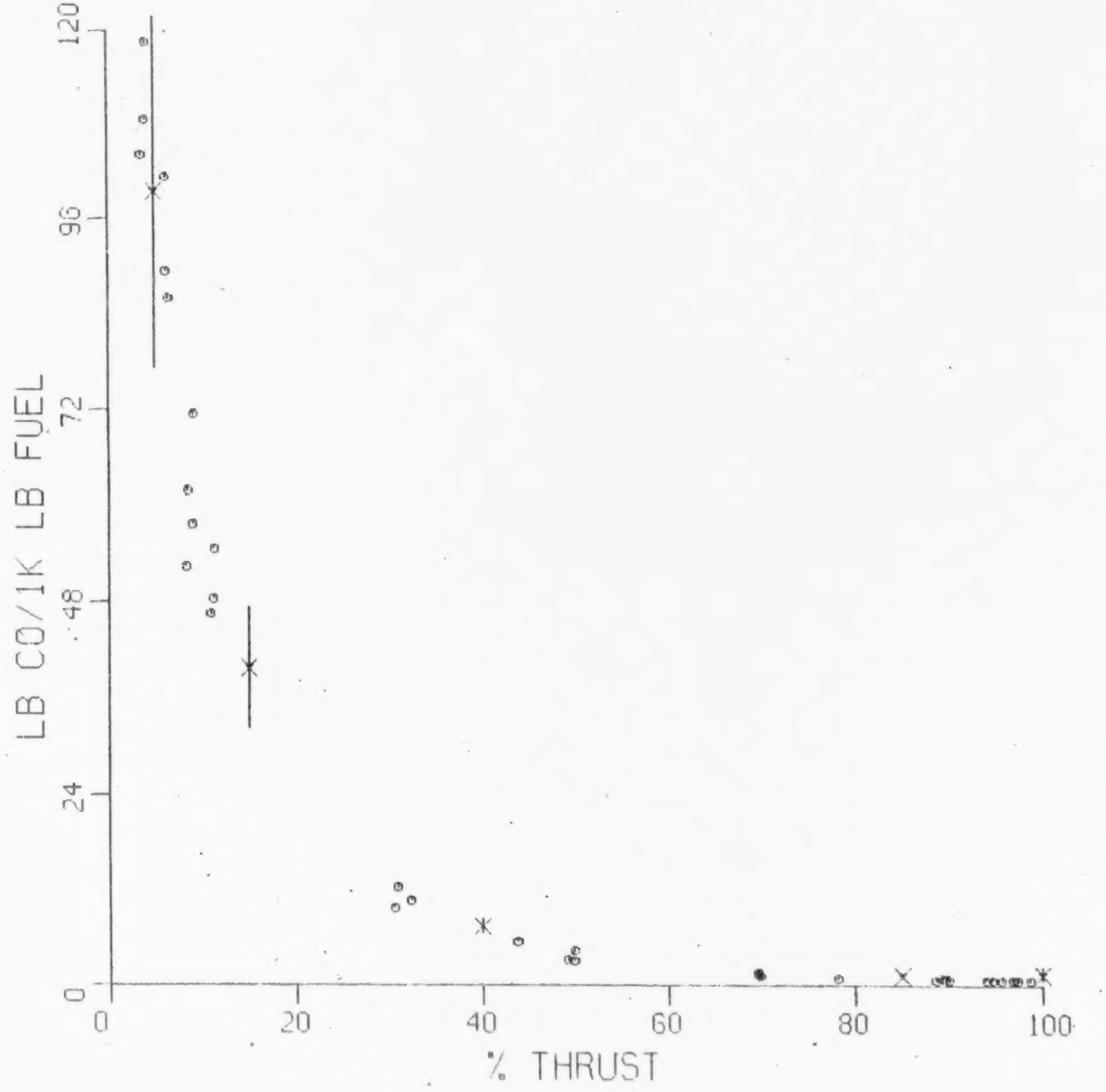


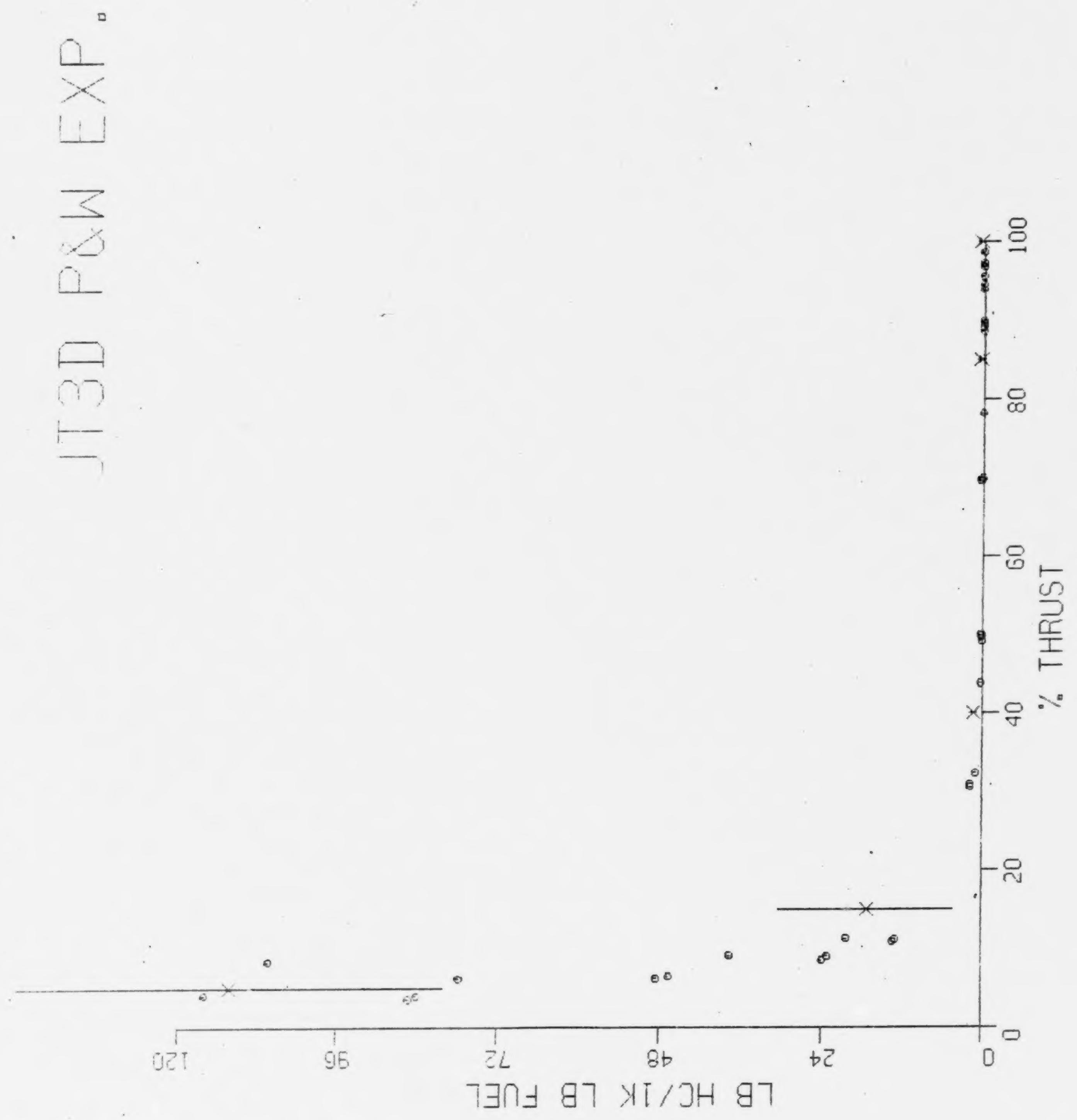
JT3D P&W




JT3D P&W
LB NOX/1K LB FUEL
0
4
8
12
16
20
0
20
40
60
80
100
% THRUST

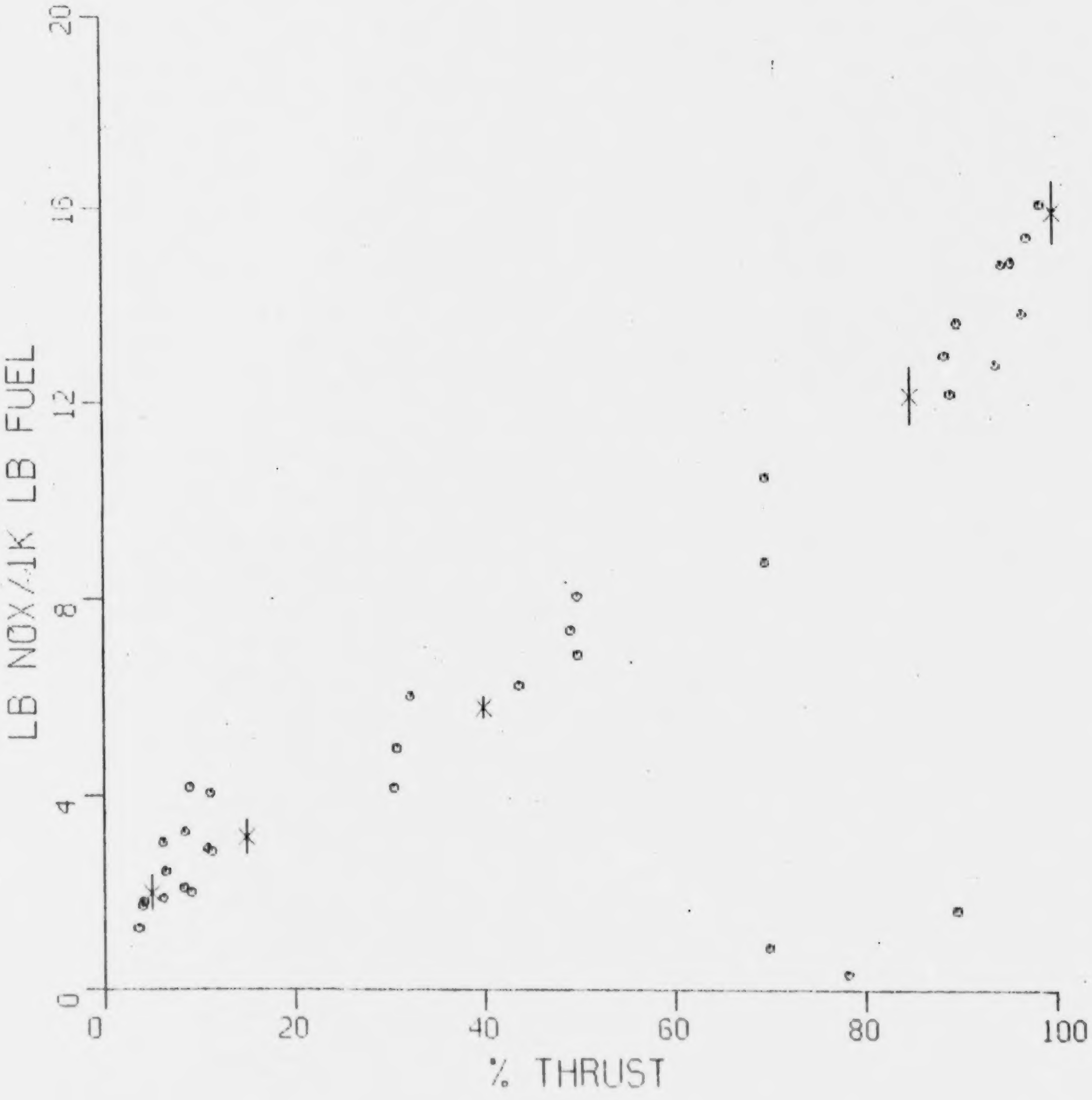
JT3D P&W EXP.

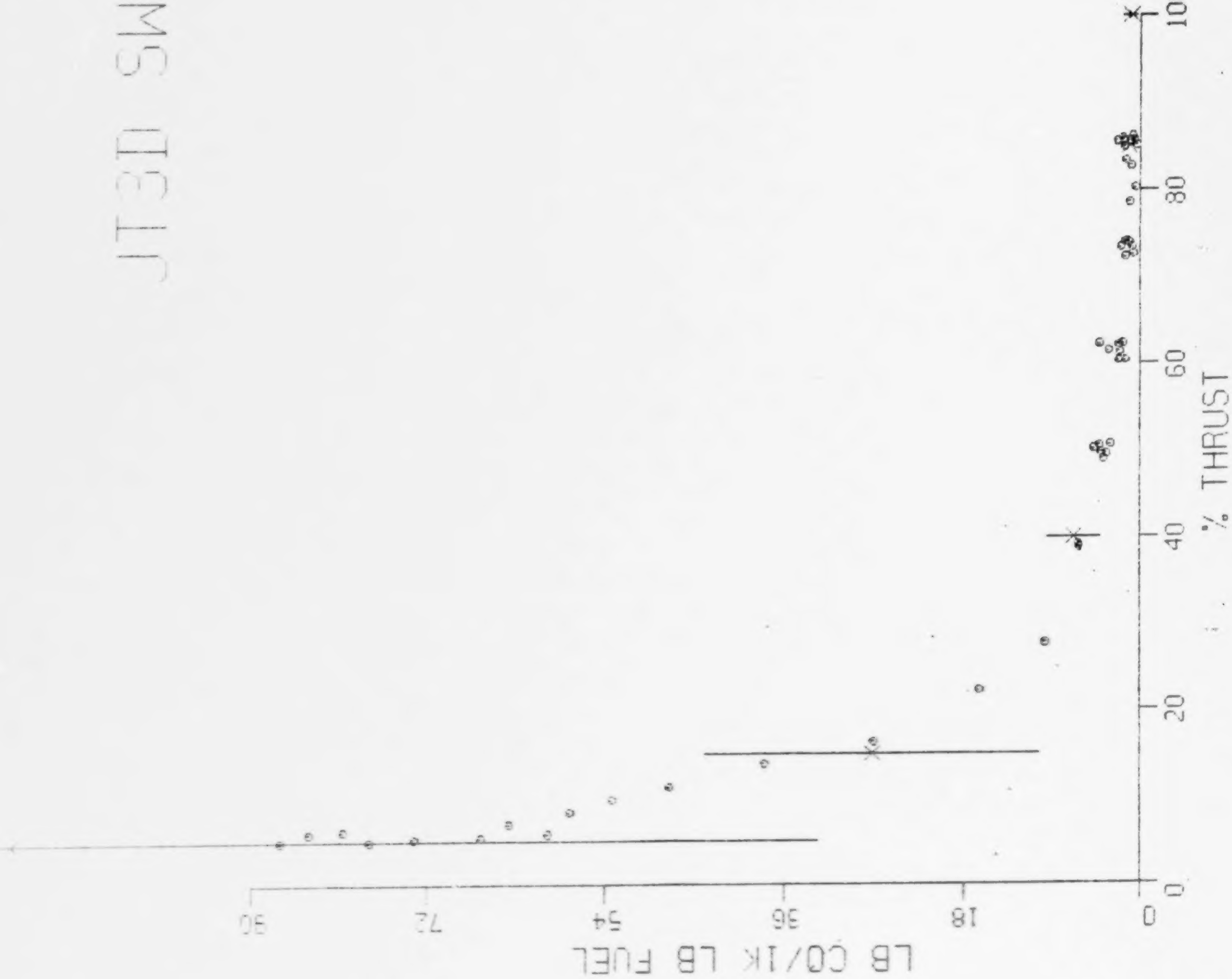


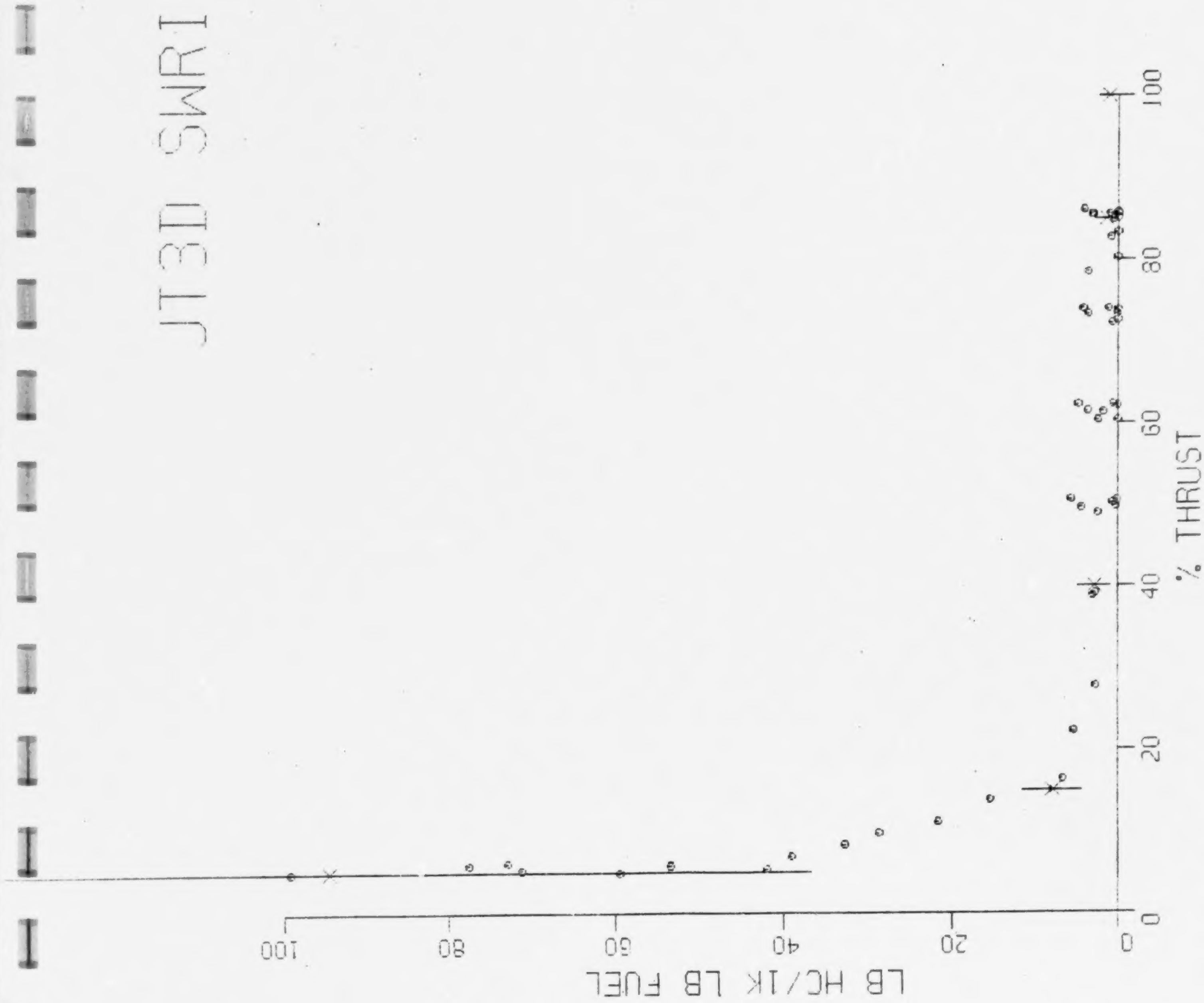


JT3D P&W EXP.

JT3D P&W EXP.




JT3D SWRI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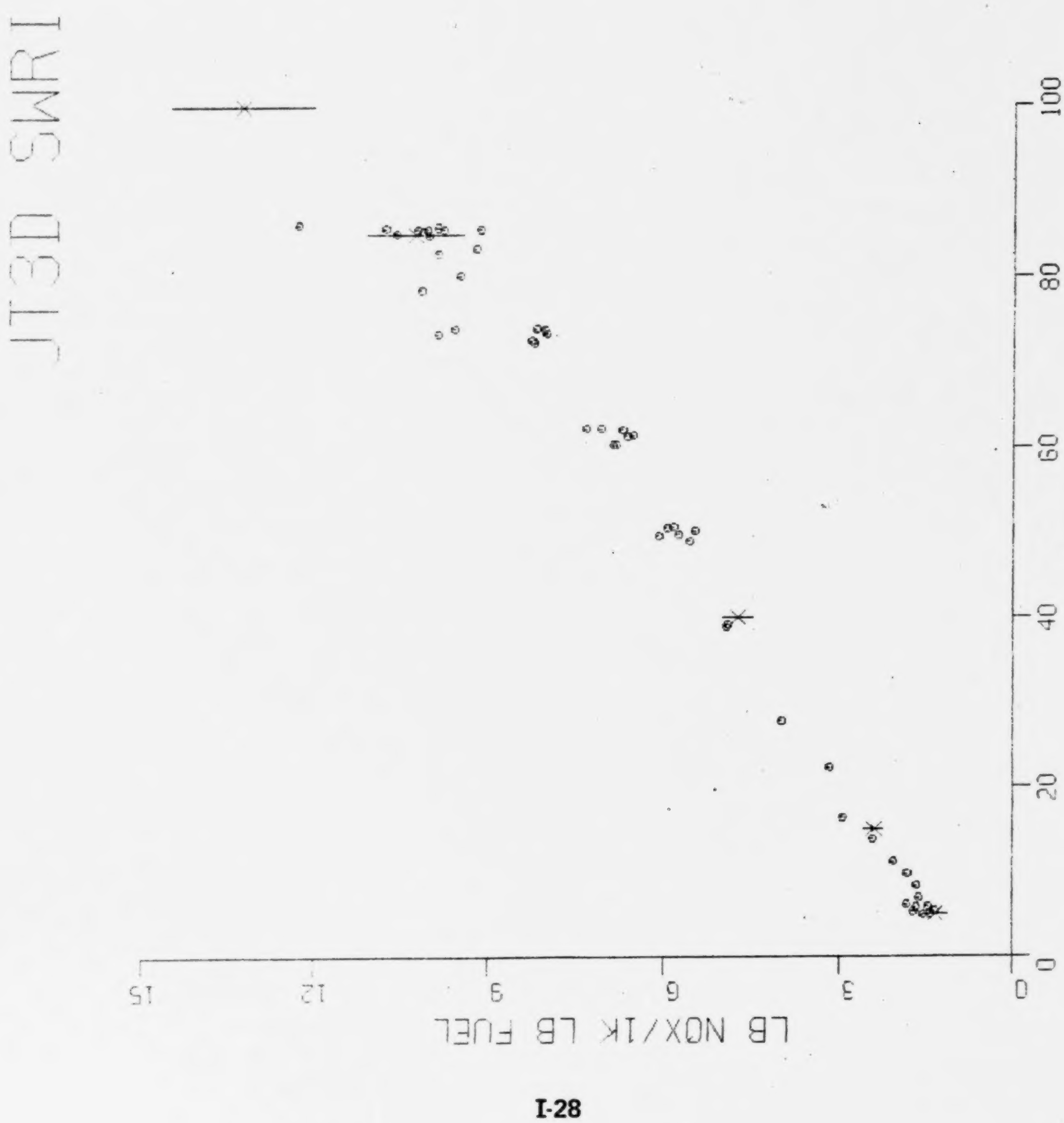
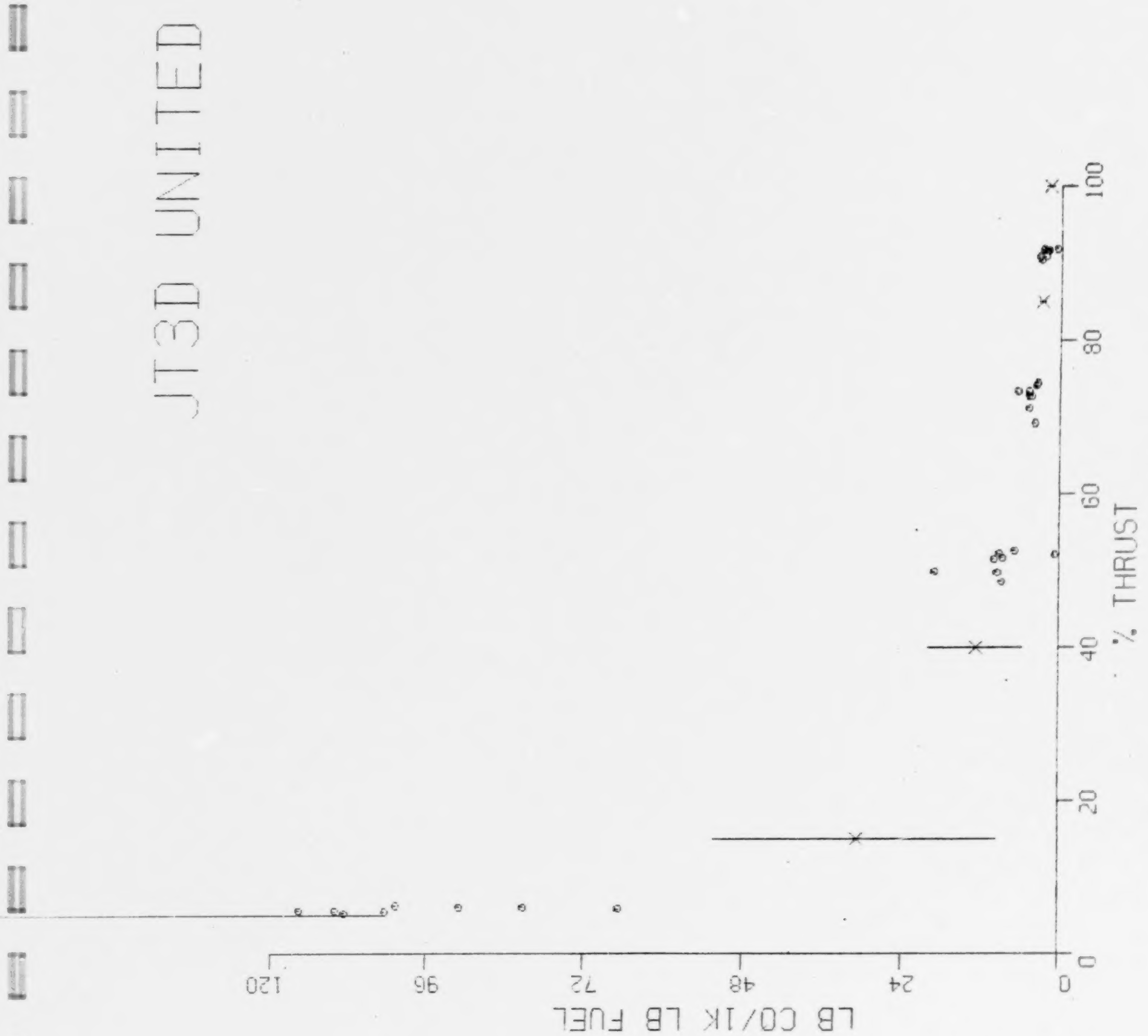
% THRUST
0
20
40
60
80
100
LB HC/1K LB FUEL
0
20
40
60
80
100


JT3D SWRI
LB NOX/1K LB FUEL
0
3
6
9
12
15
% THRUST
0
20
40
60
80
100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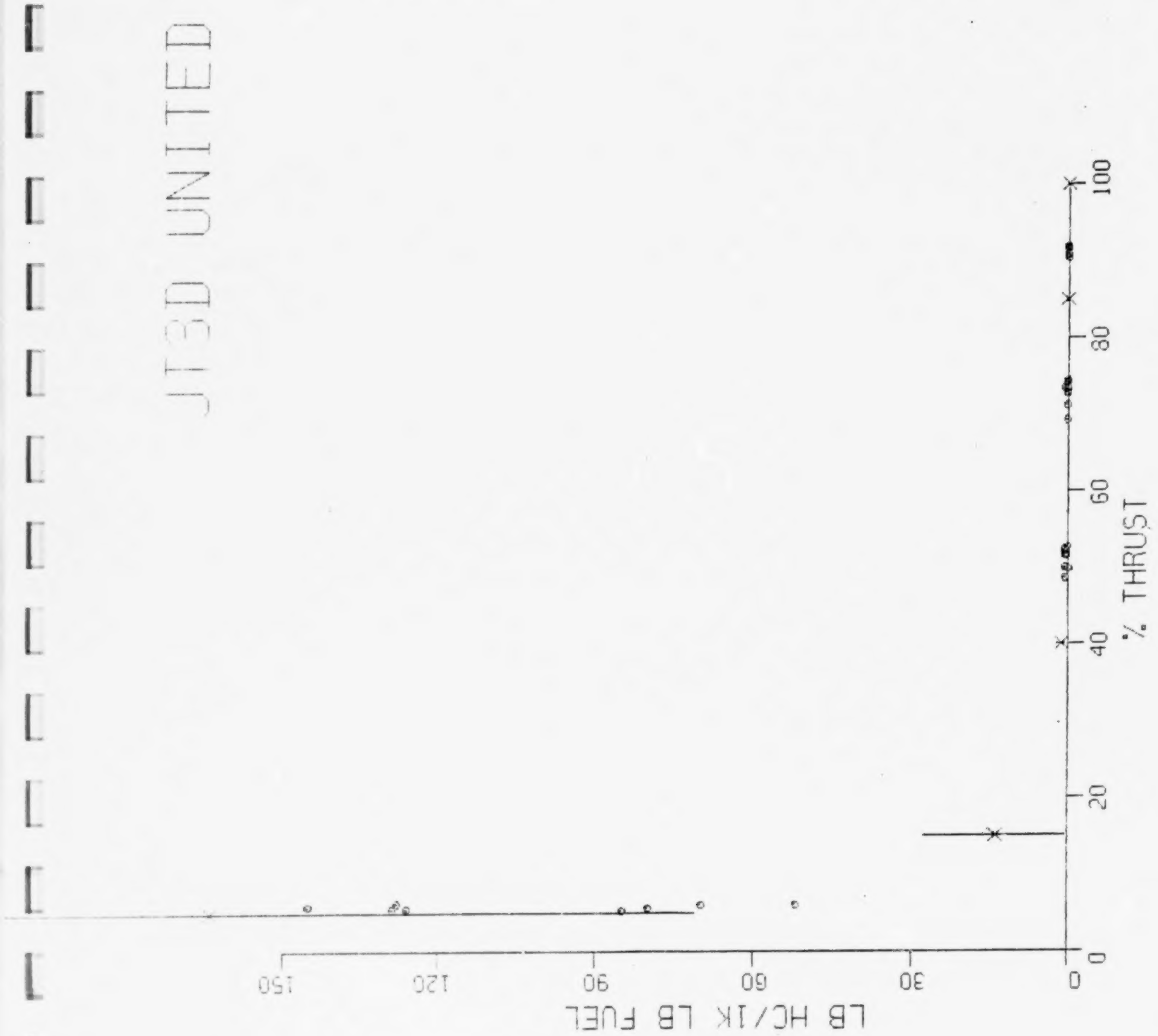
LB CO/1K LB FUEL
0
24
48
72
96
120
% THRUST
0
20
40
60
80
100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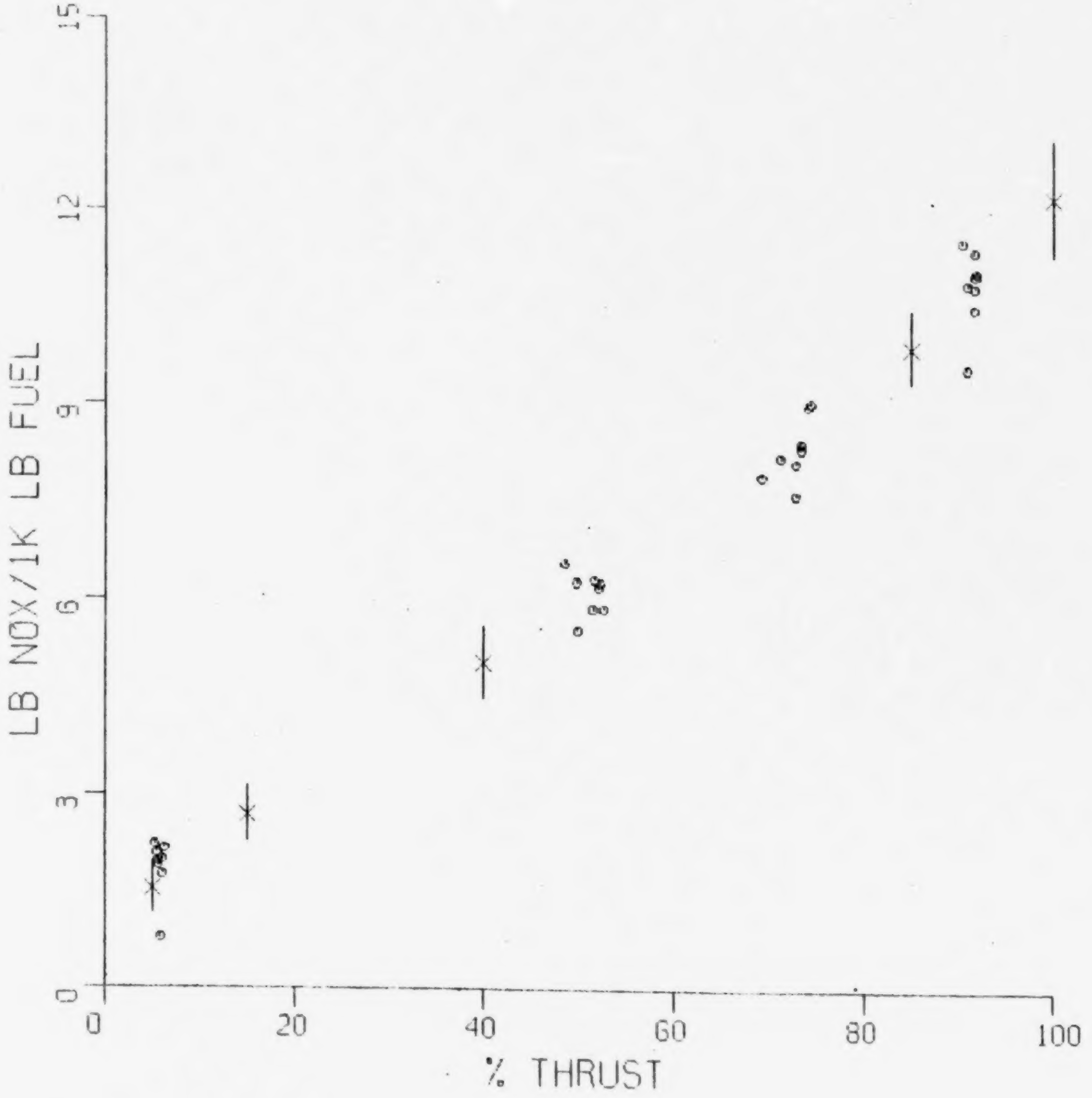
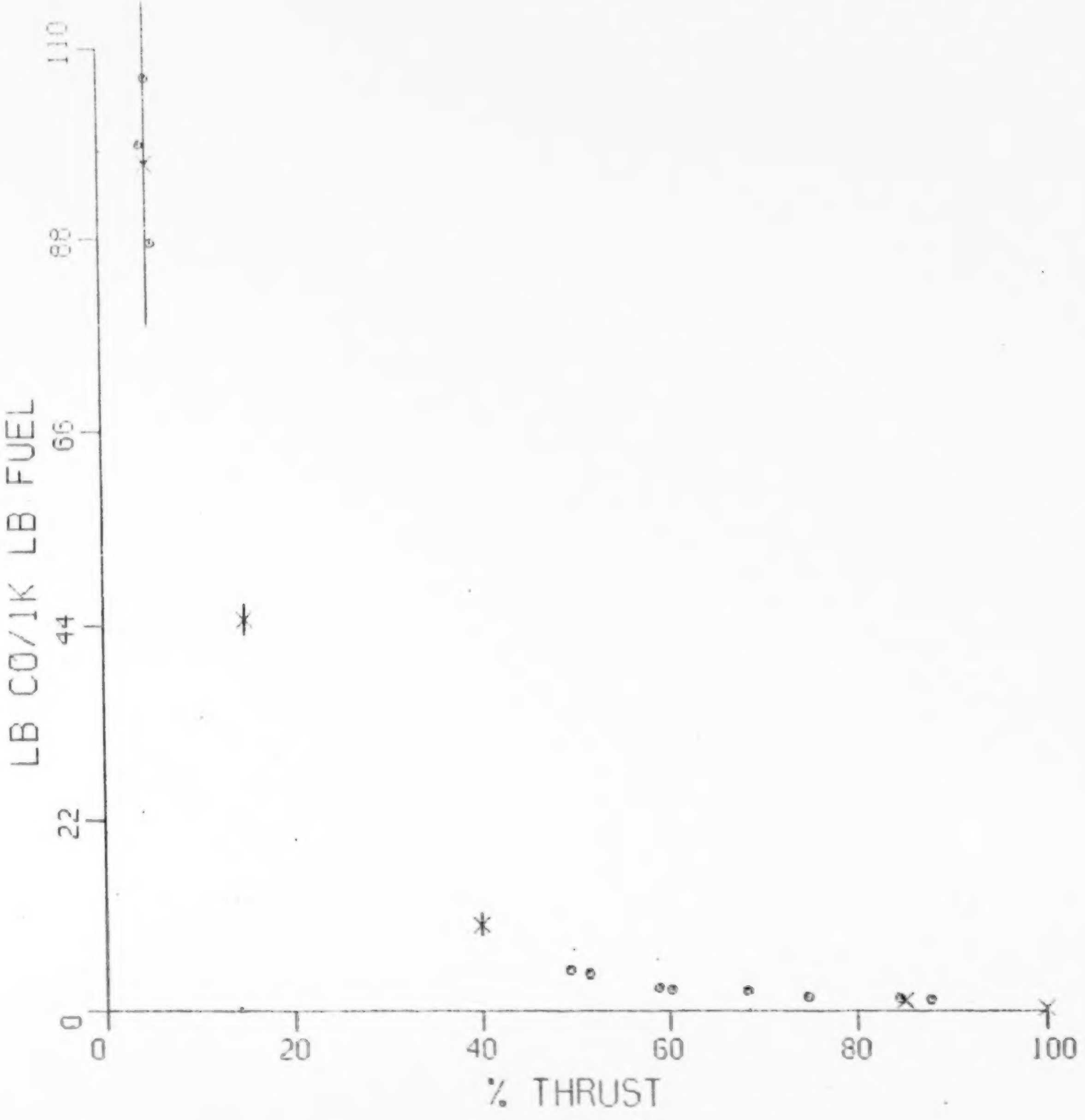
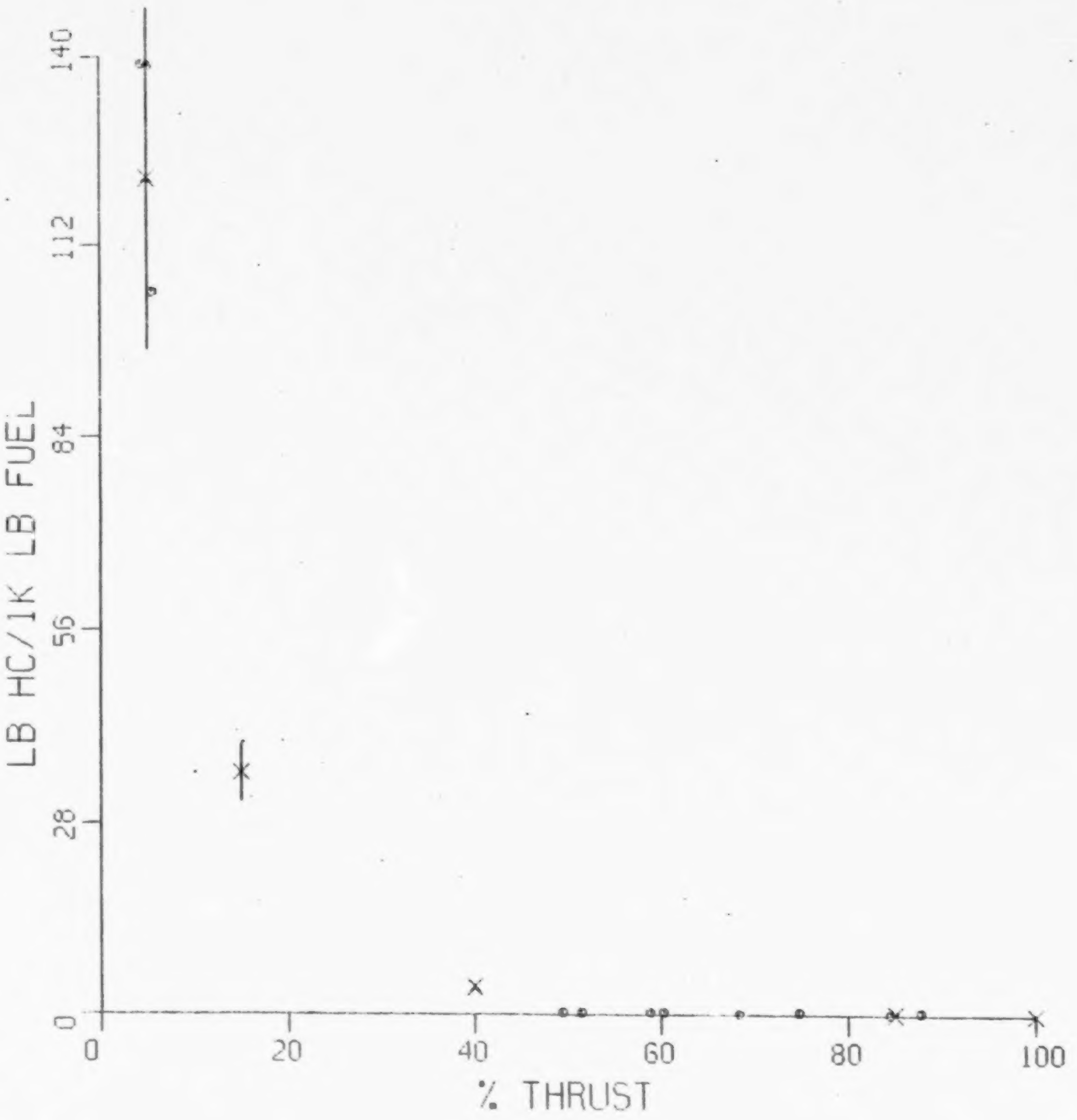
LB HC/1K LB FUEL
0
30
60
90
120
150
% THRUST
0
20
40
60
80
100

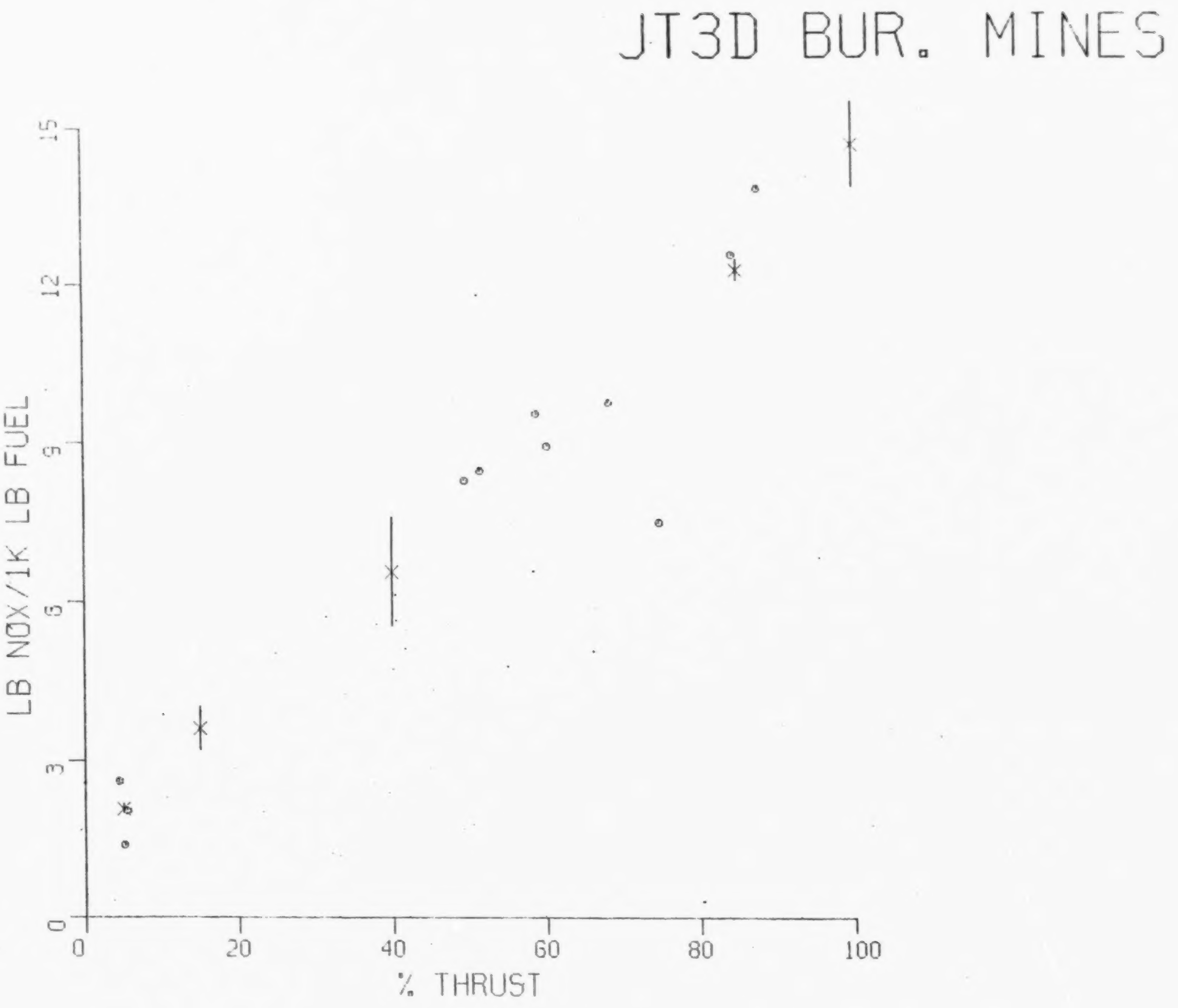

JT3D UNITED
LB NOX/1K LB FUEL
0
3
6
9
12
15
% THRUST
0
20
40
60
80
100

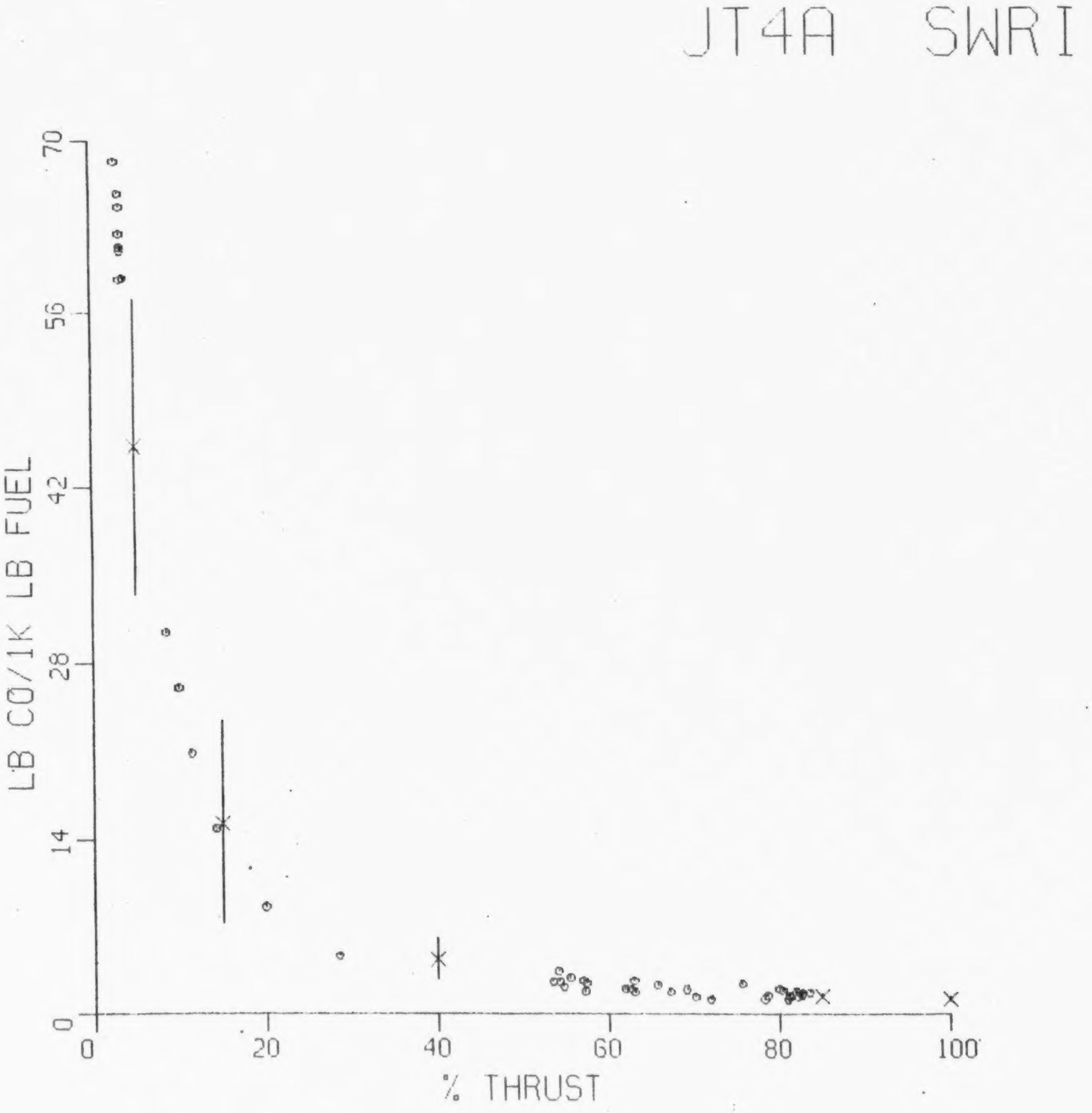
JT3D BUR. MINES



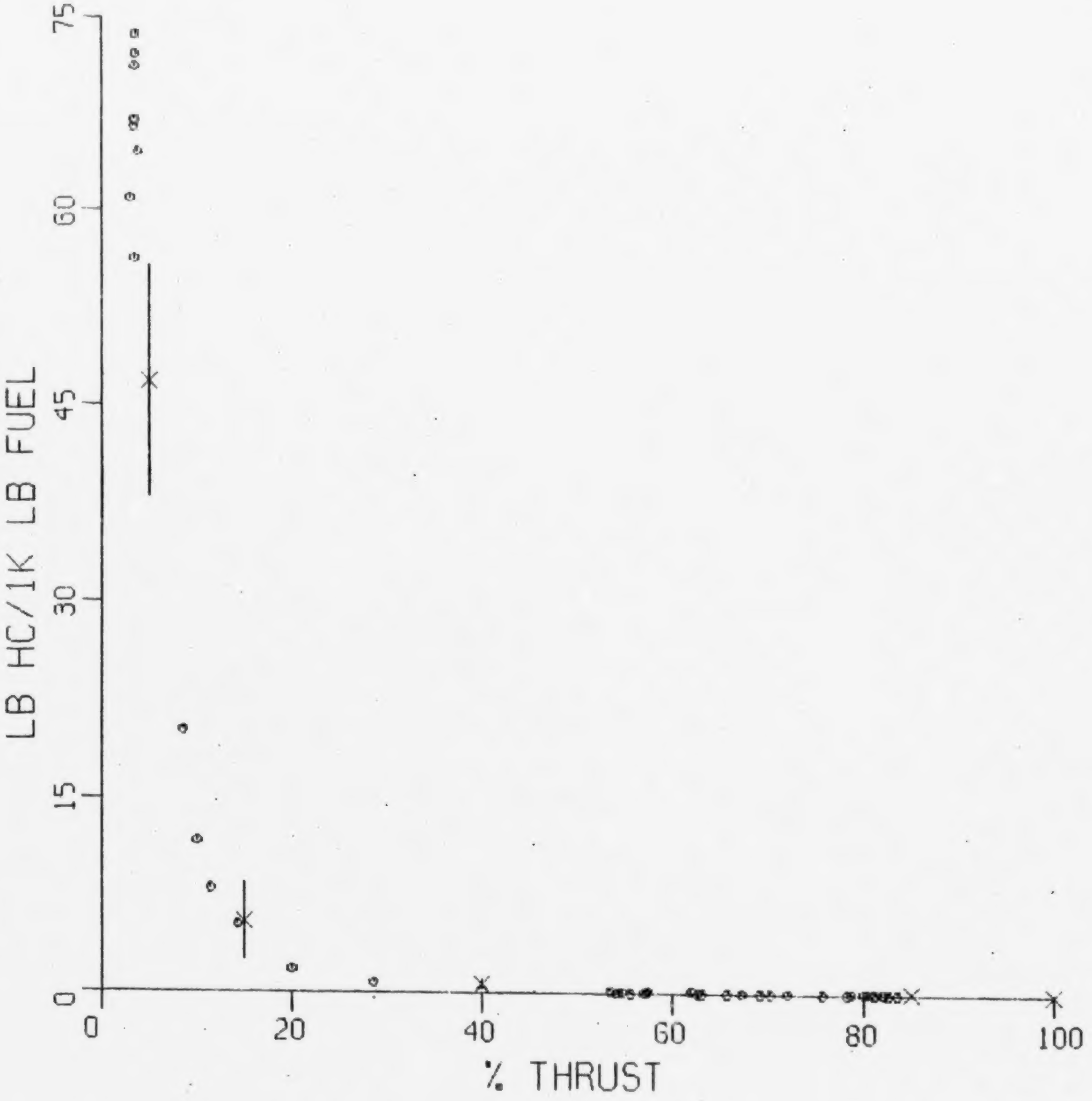
JT3D BUR. MINES

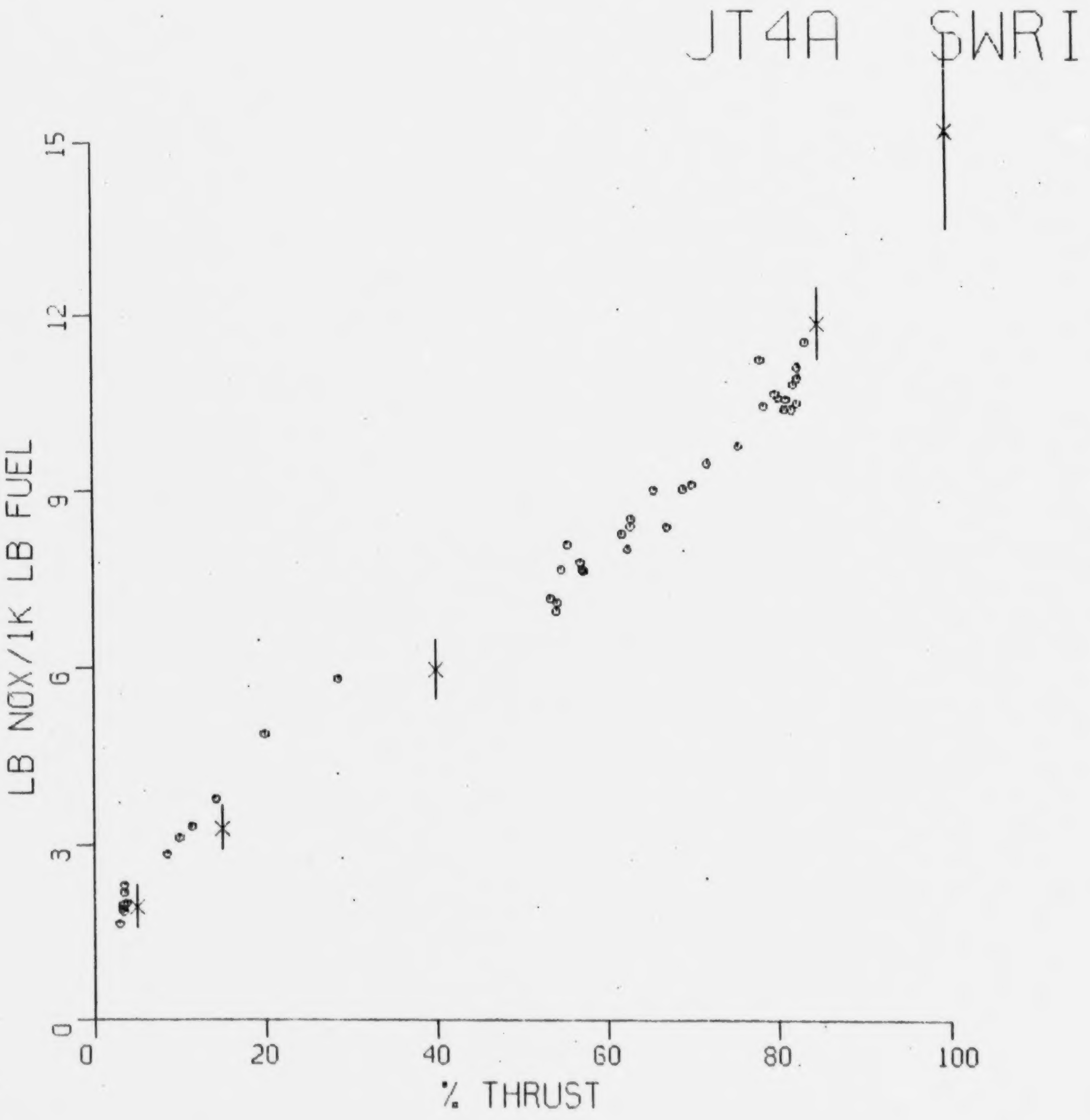


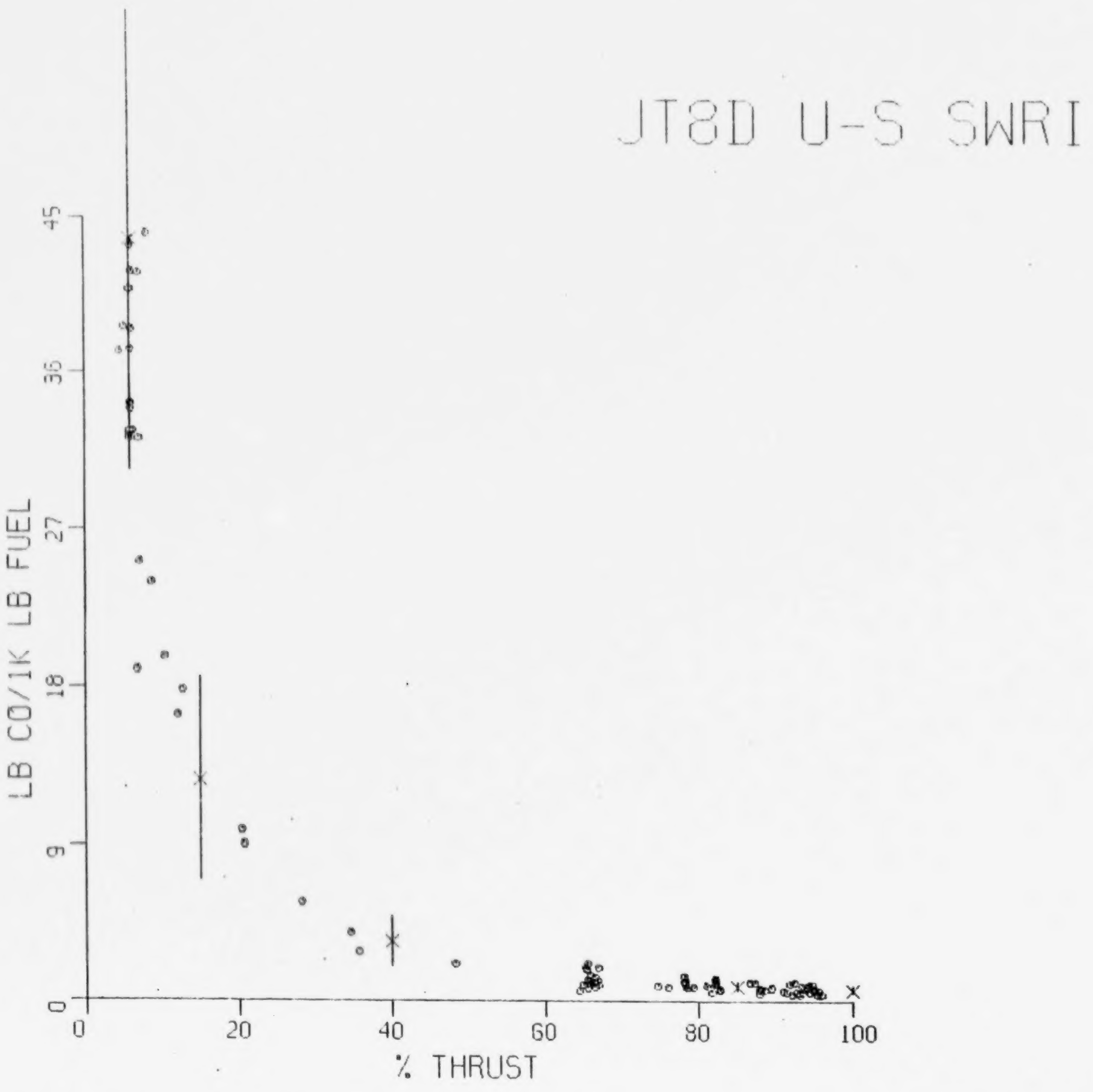

JT3D BUR. MINES
LB NOX/1K LB FUEL
0
3
6
9
12
15
0
20
40
60
80
100
% THRUST

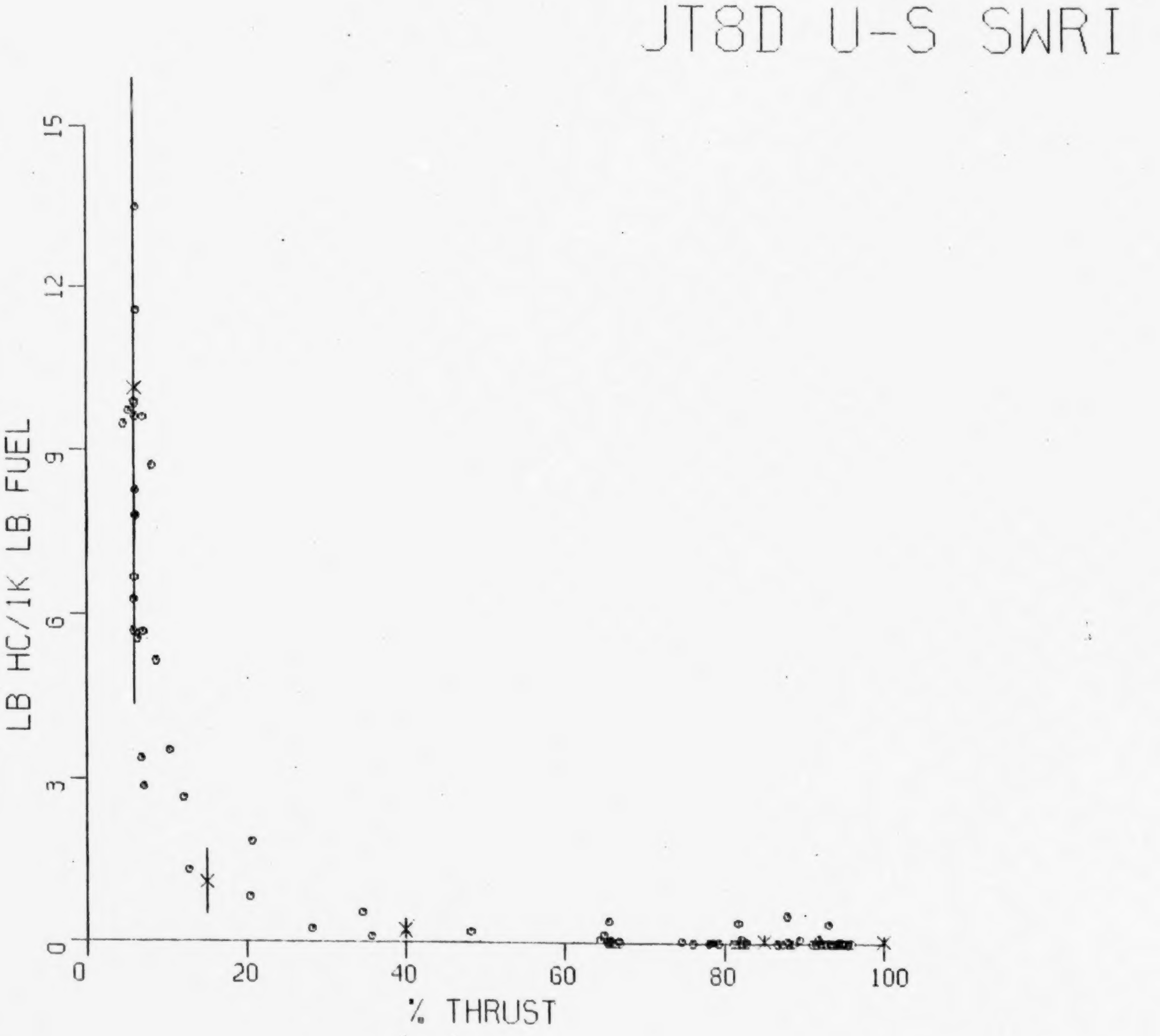

JT4A SWRI
LB CO/1K LB FUEL
0
14
28
42
56
70
0
20
40
60
80
100
% THRUST

JT4A SWRI




JT4A SWRI
LB NOX/1K LB FUEL
0
3
6
9
12
15
0
20
40
60
80
100
% THRUST


JT8D U-S SWRI
LB CO/1K LB FUEL
0
9
18
27
36
45
% THRUST
0
20
40
60
80
100


JT8D U-S SWRI
LB HC/1K LB FUEL
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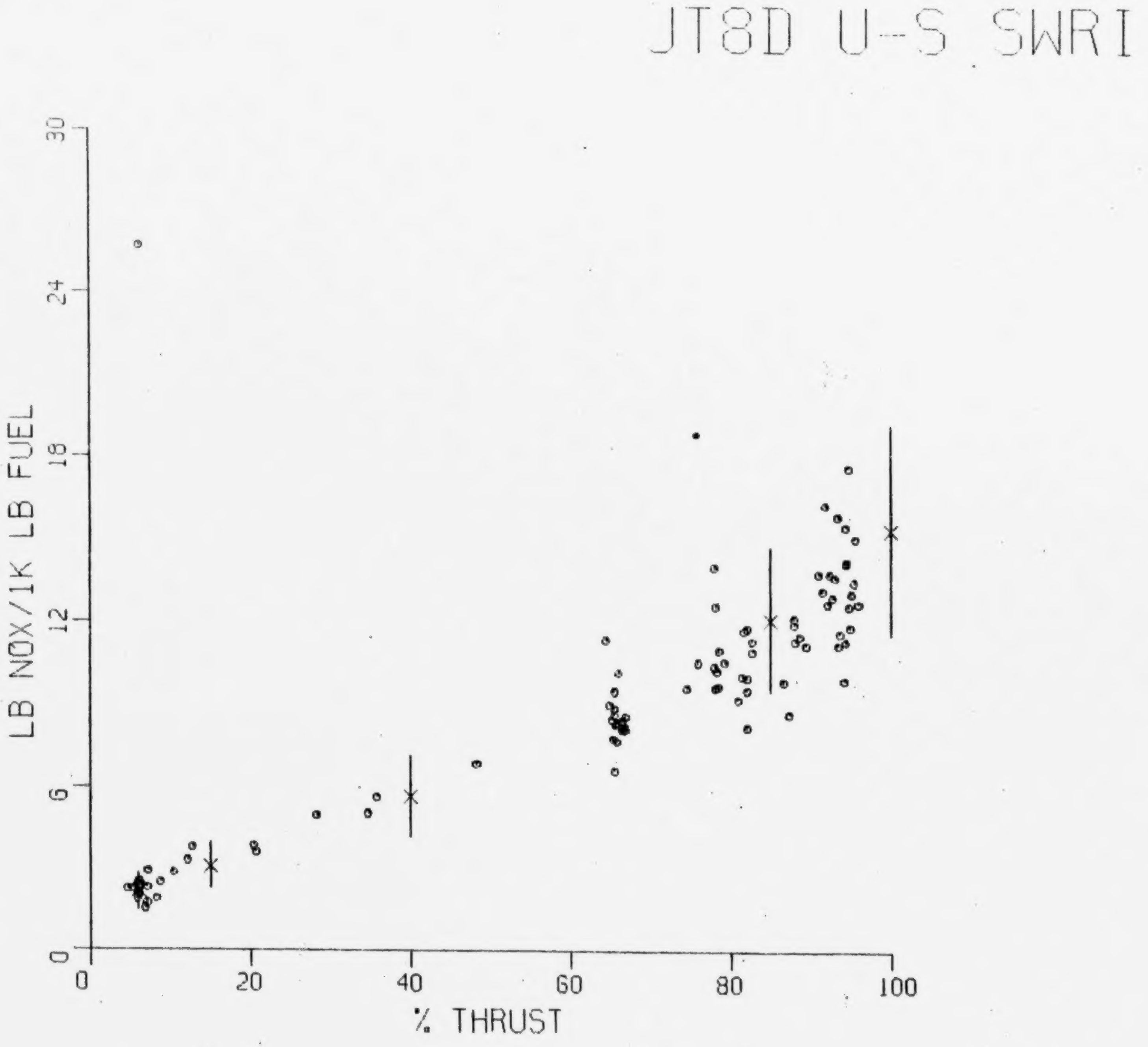
3
6
9
12
15
0
20
40
60
80
100
% THRUST


JT8D U-S SWRI
LB NOX/1K LB FUEL
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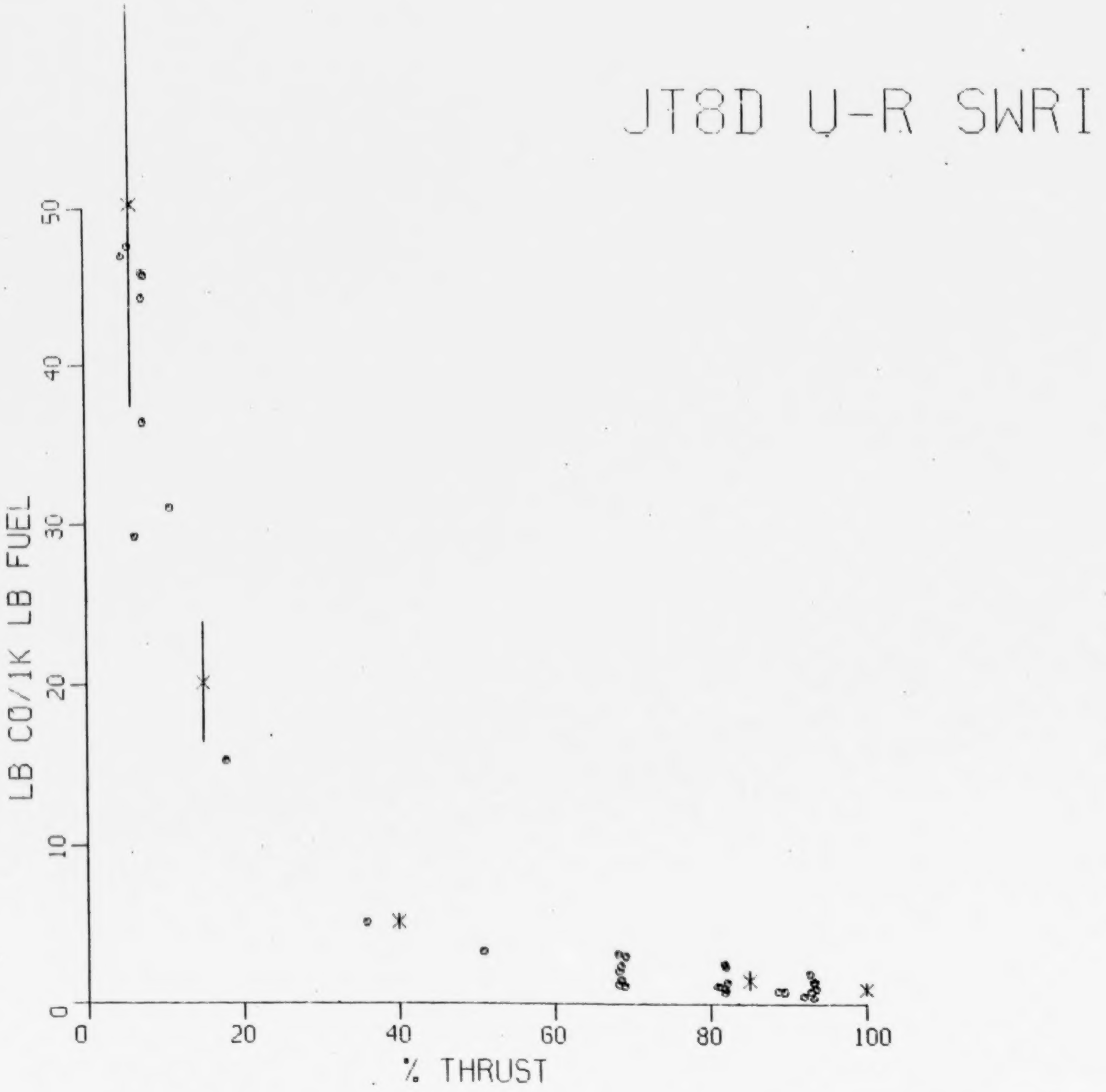
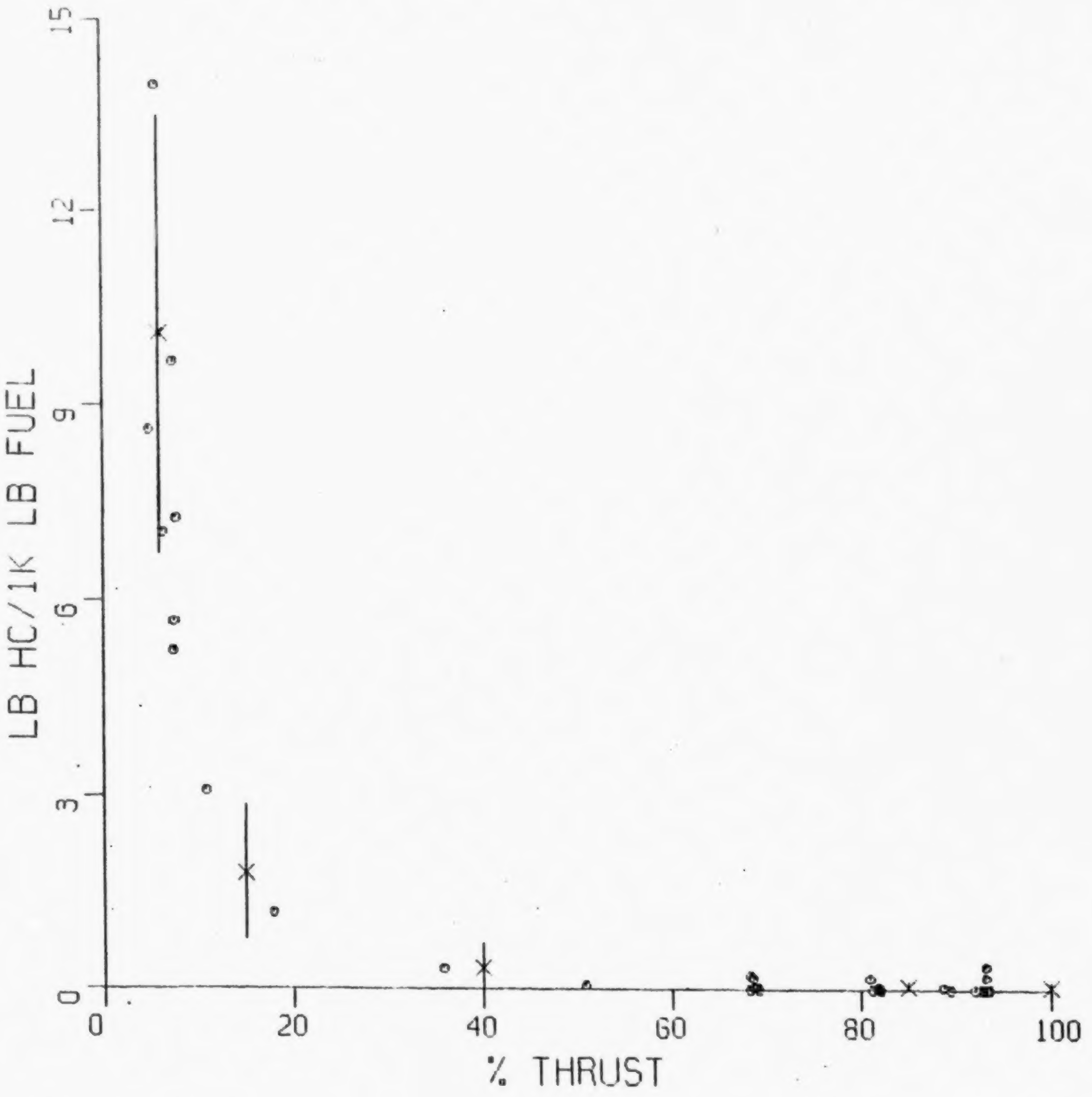
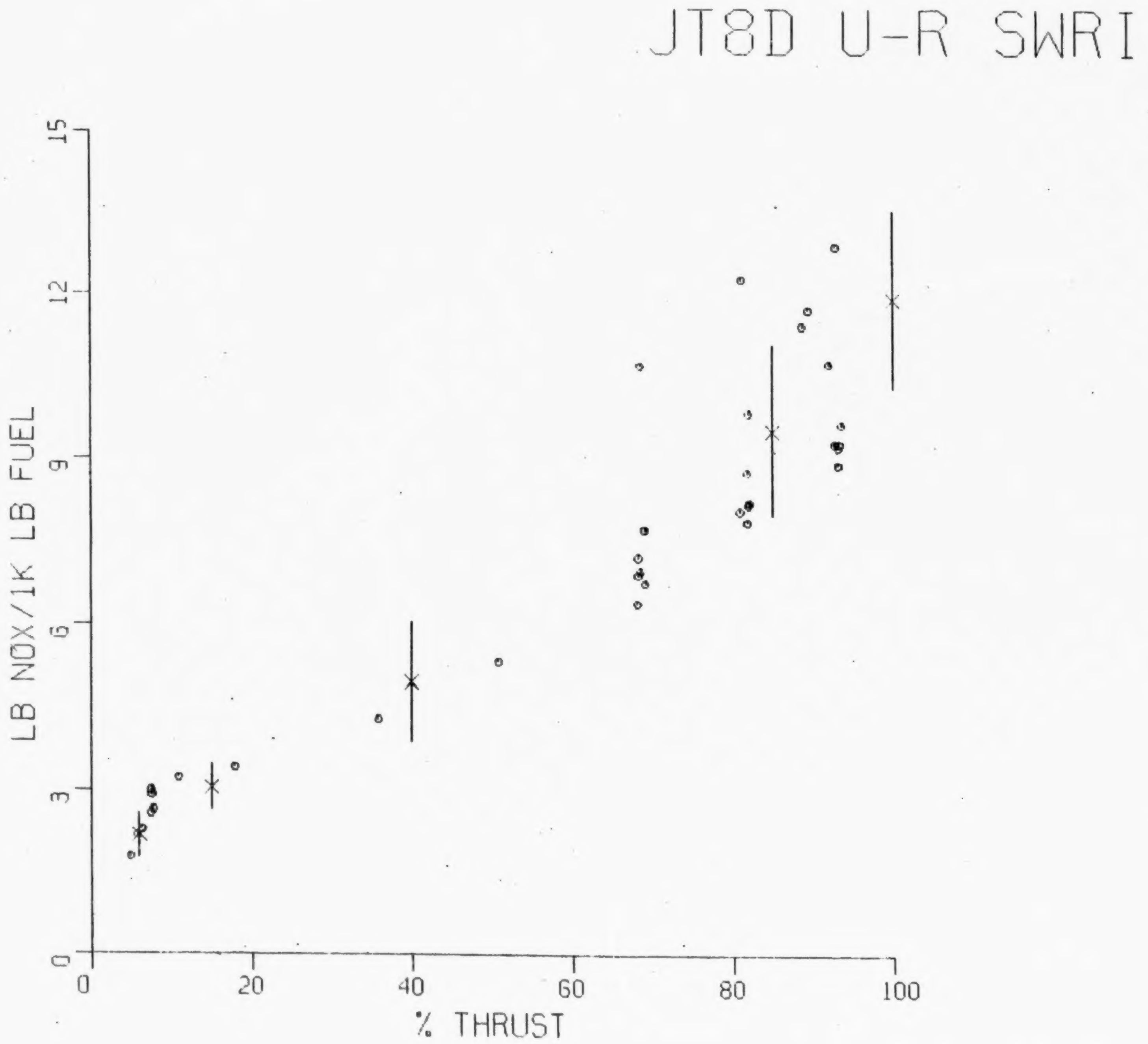
6
12
18
24
30
0
20
40
60
80
100
% THRUST

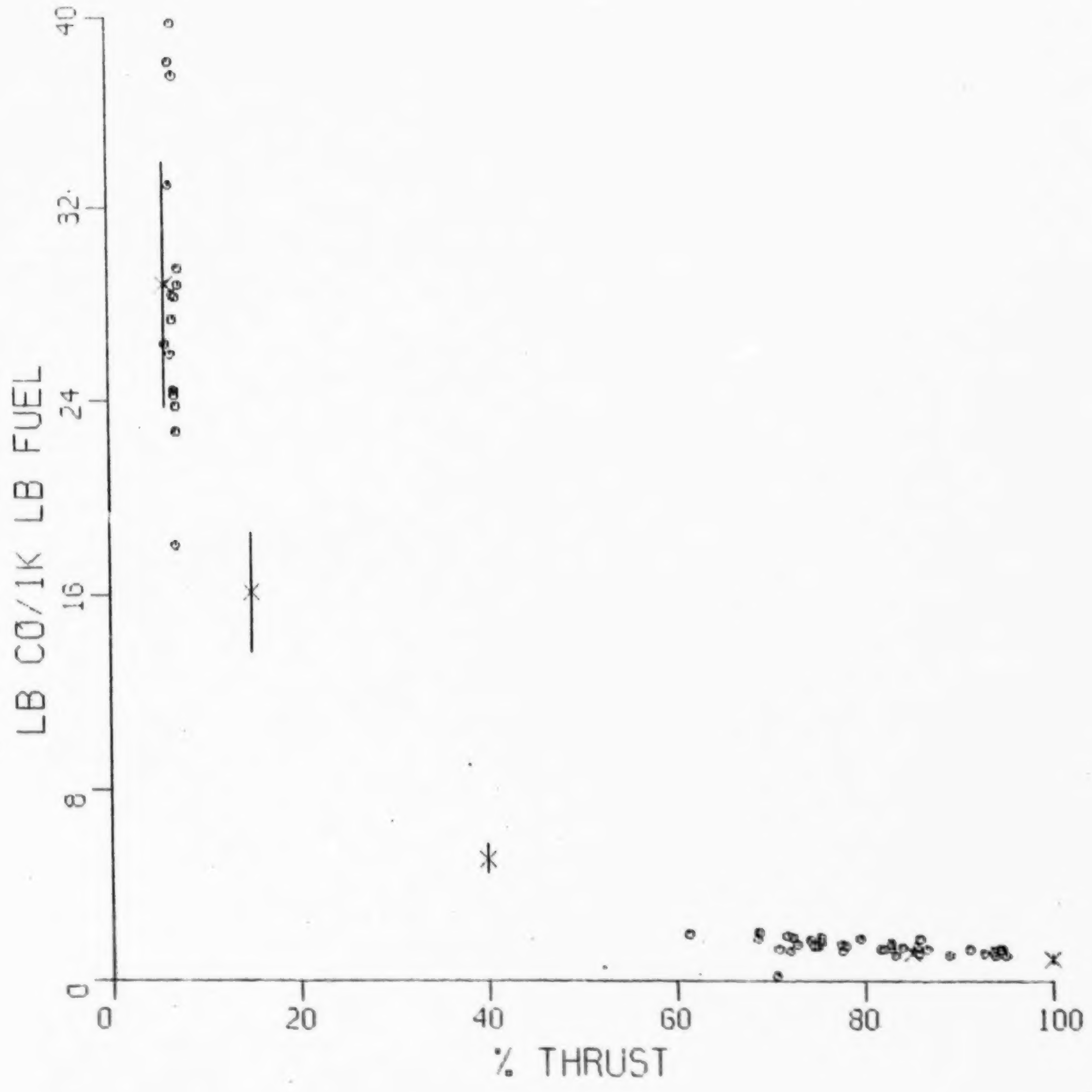

JT8D U-R SWRI
LB CO/1K LB FUEL
0
10
20
30
40
50
0
20
40
60
80
100
% THRUST

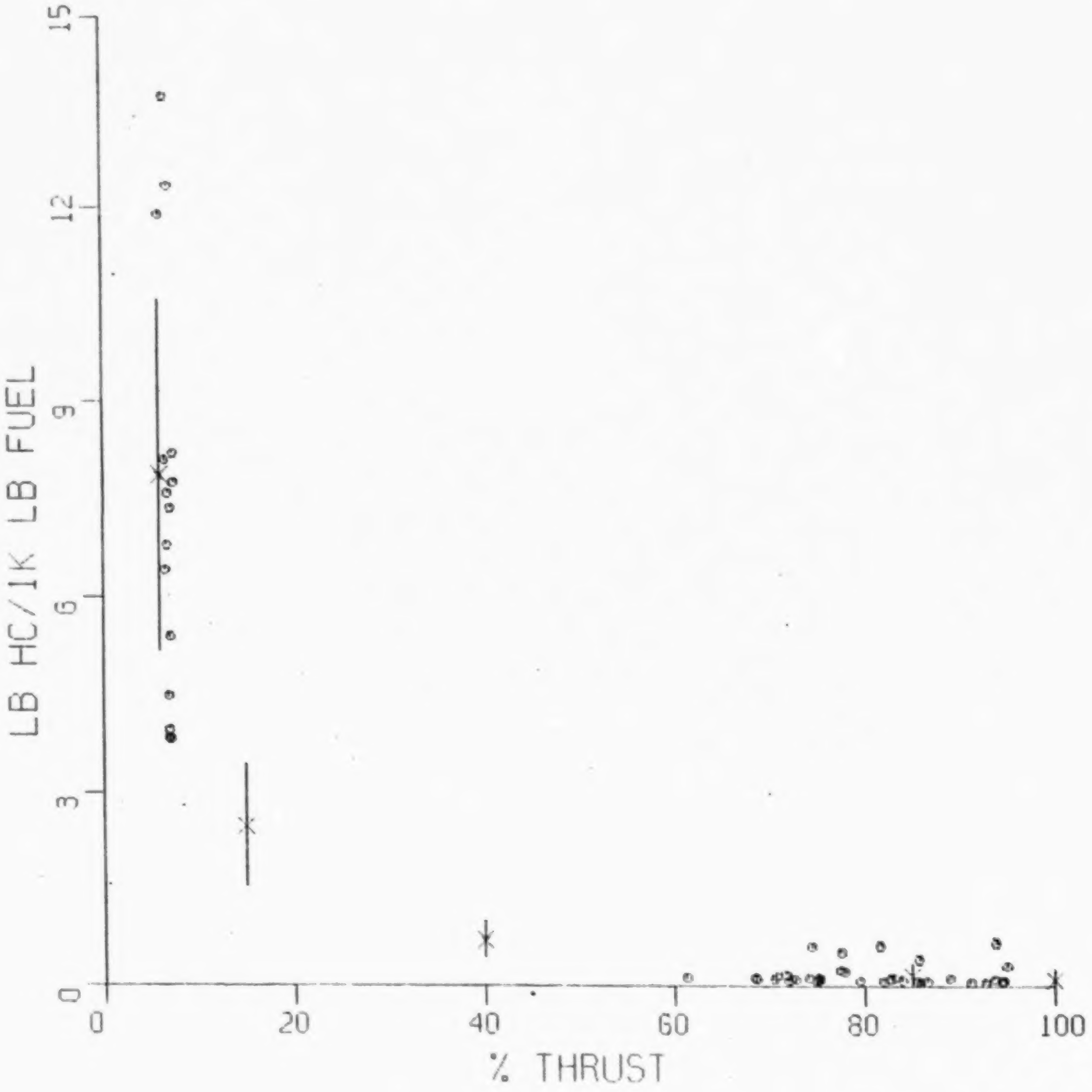
JT8D U-R SWRI



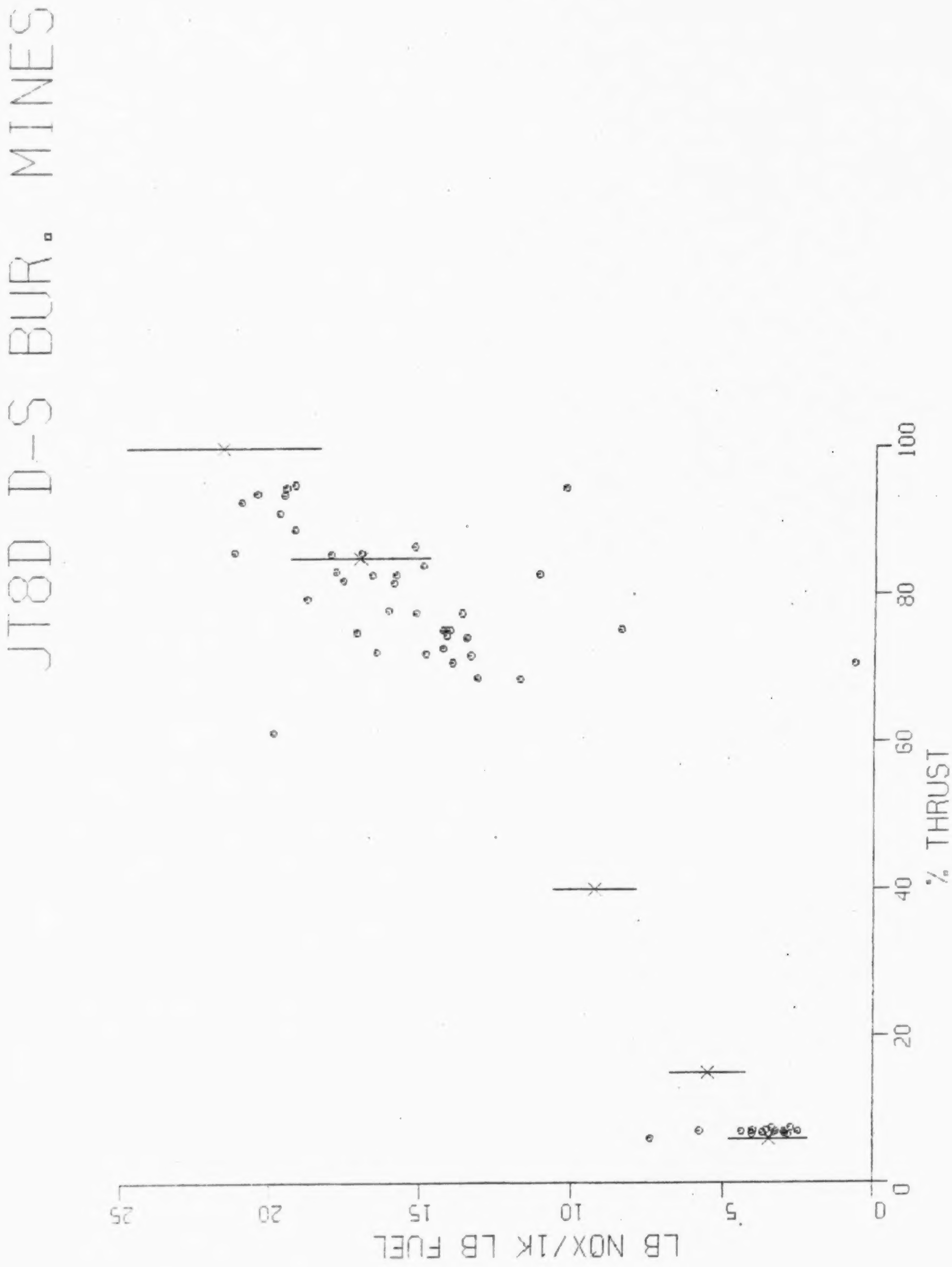

JT8D U-R SWRI
LB NOX/1K LB FUEL
0
3
6
9
12
15
0
20
40
60
80
100
% THRUST

JT8D D-S BUR. MINES

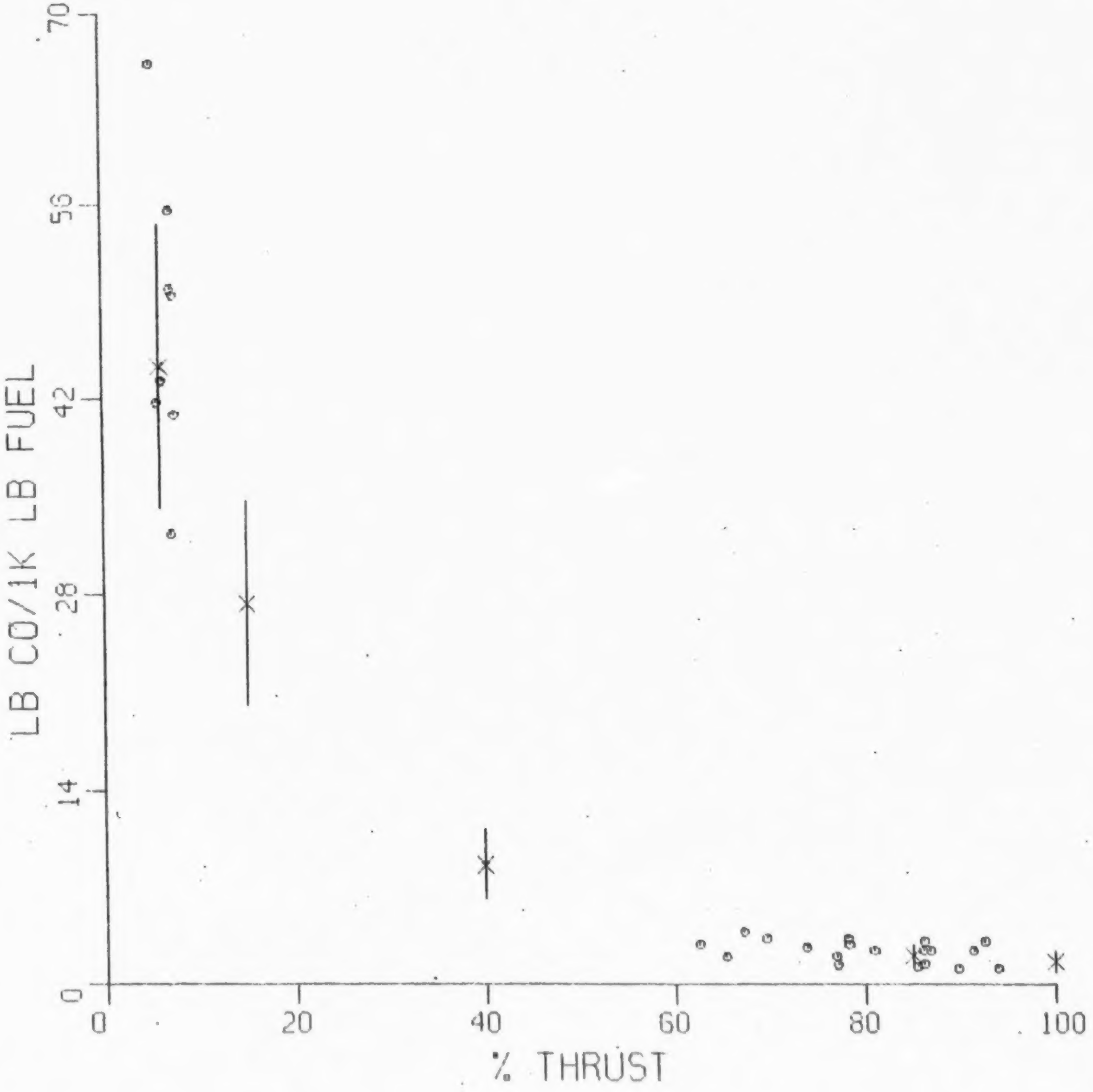




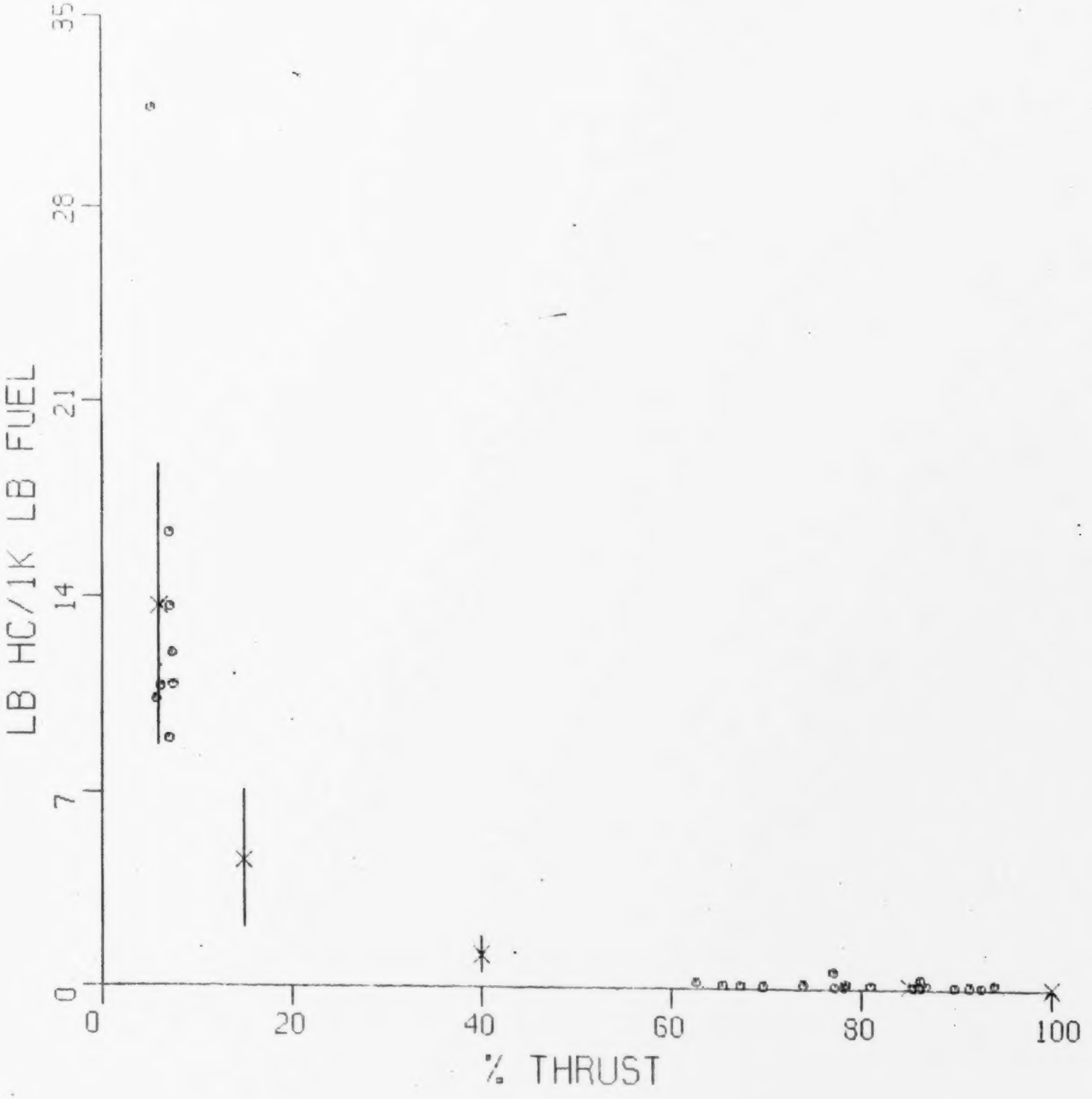
JT8D D-S BUR. MINES


JT8D D-S BUR. MINES
LB NOX/1K LB FUEL
0
5
10
15
20
25
% THRUST
0
20
40
60
80
100

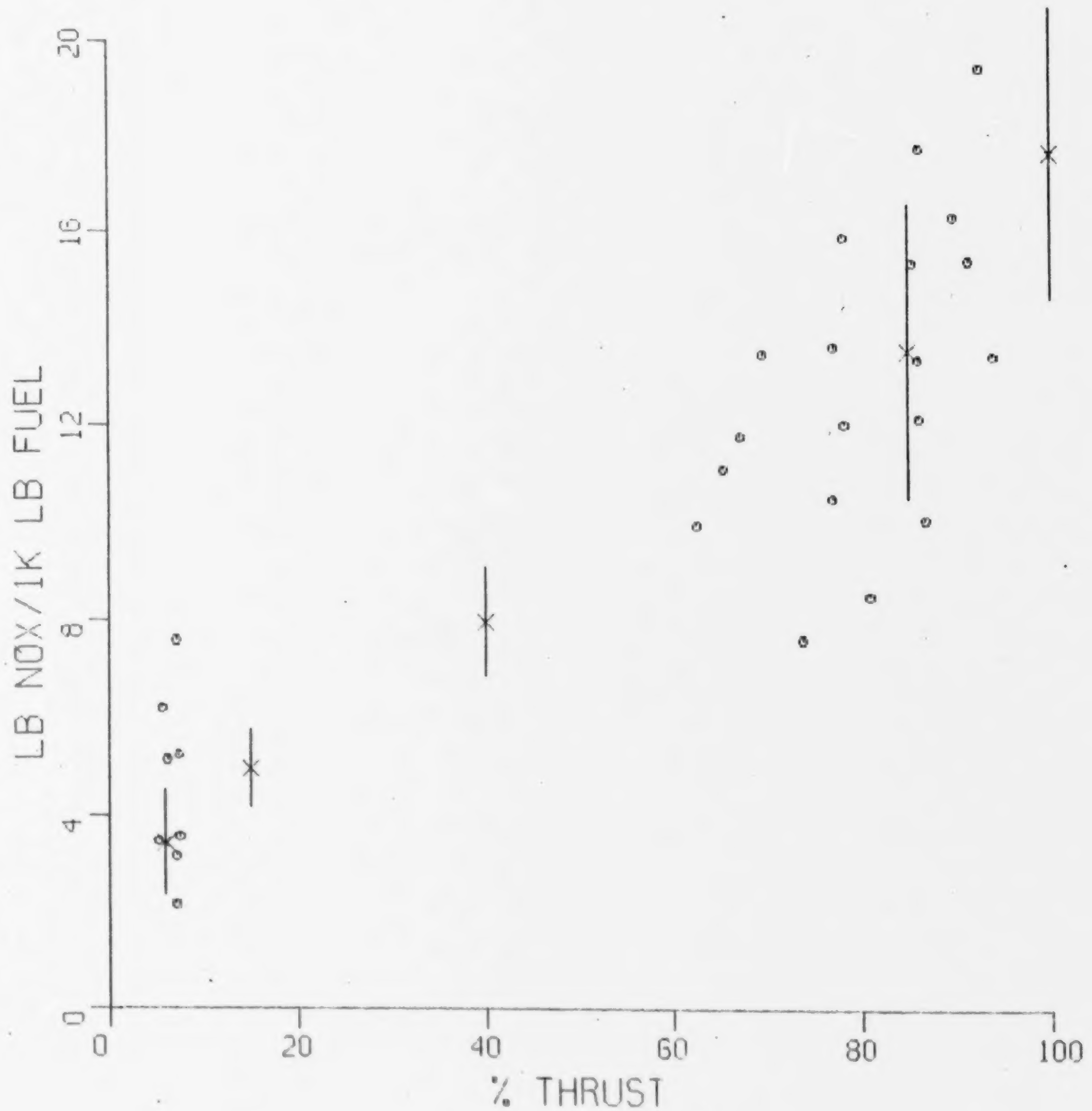
JT8D D-R BUR. MINES

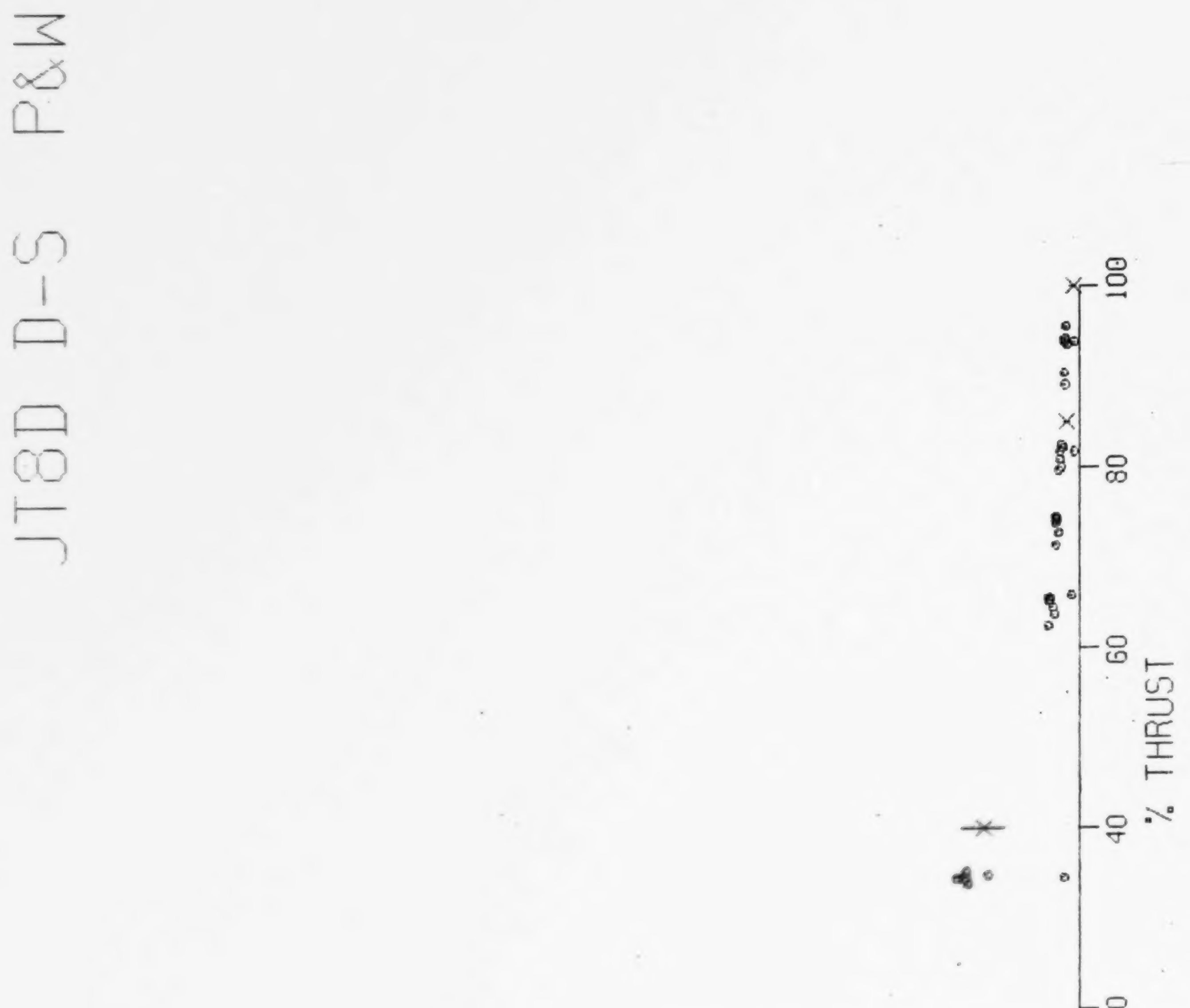


JT8D D-R BUR. MINES

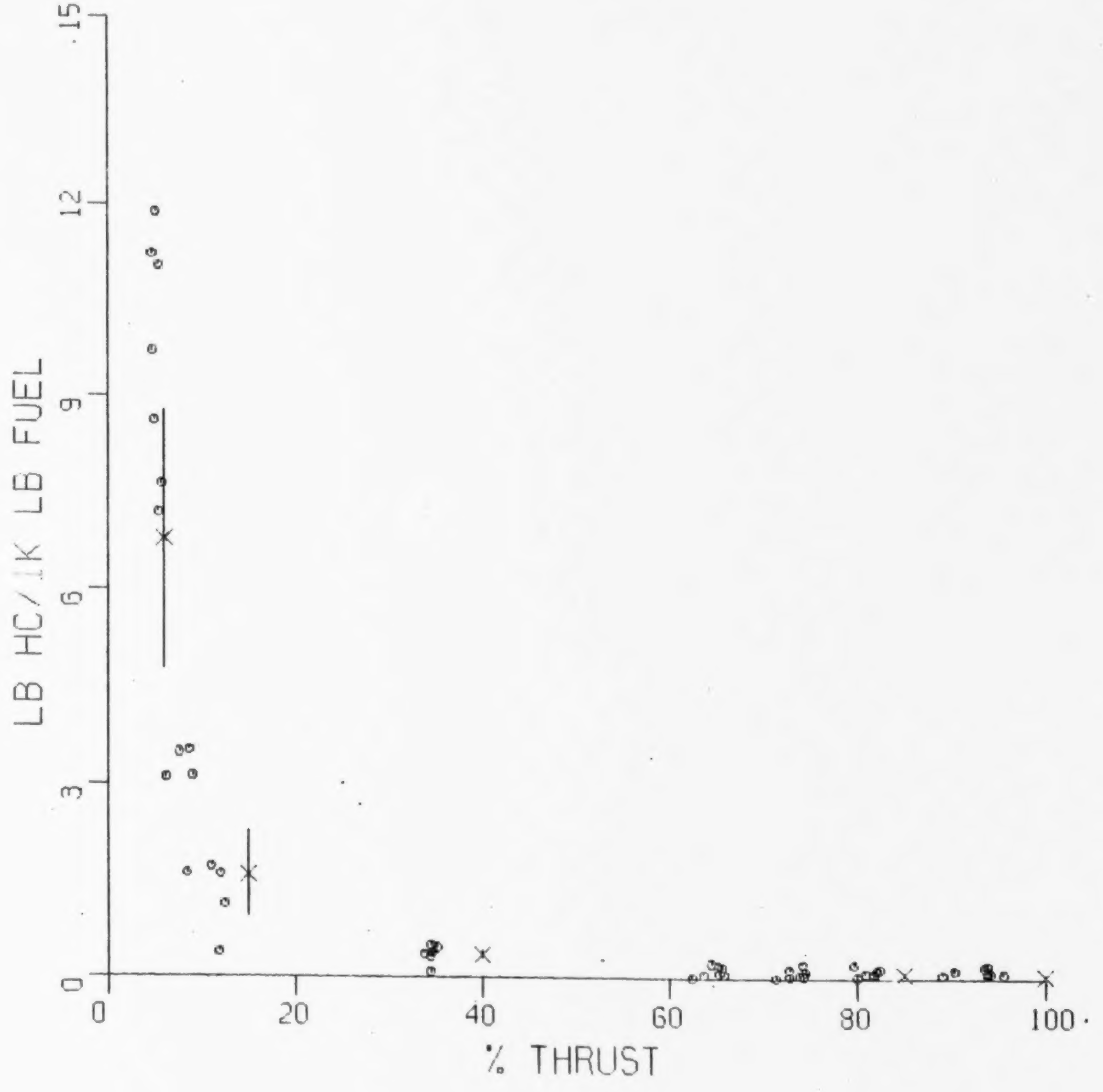


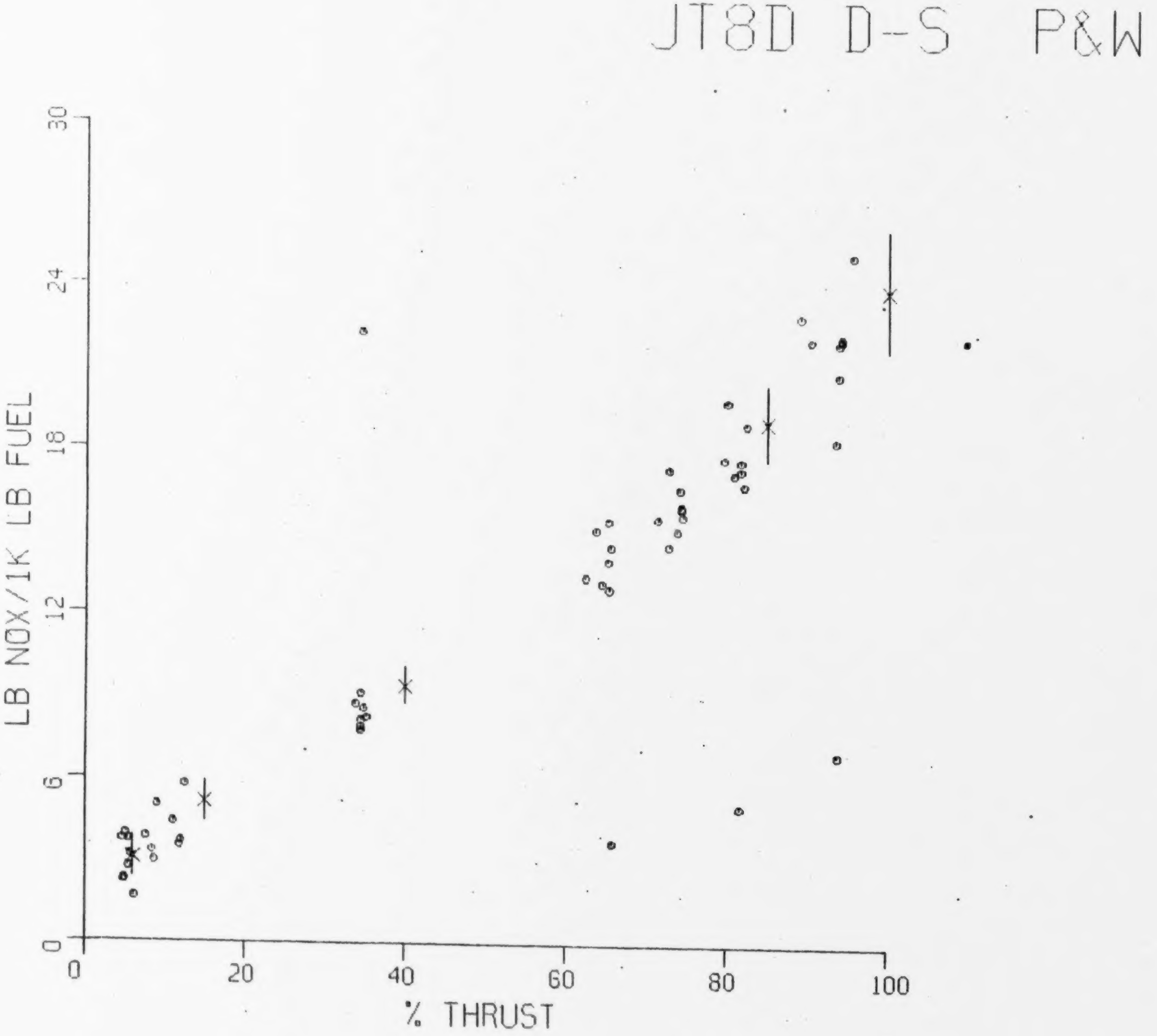
JT8D D-R BUR. MINES

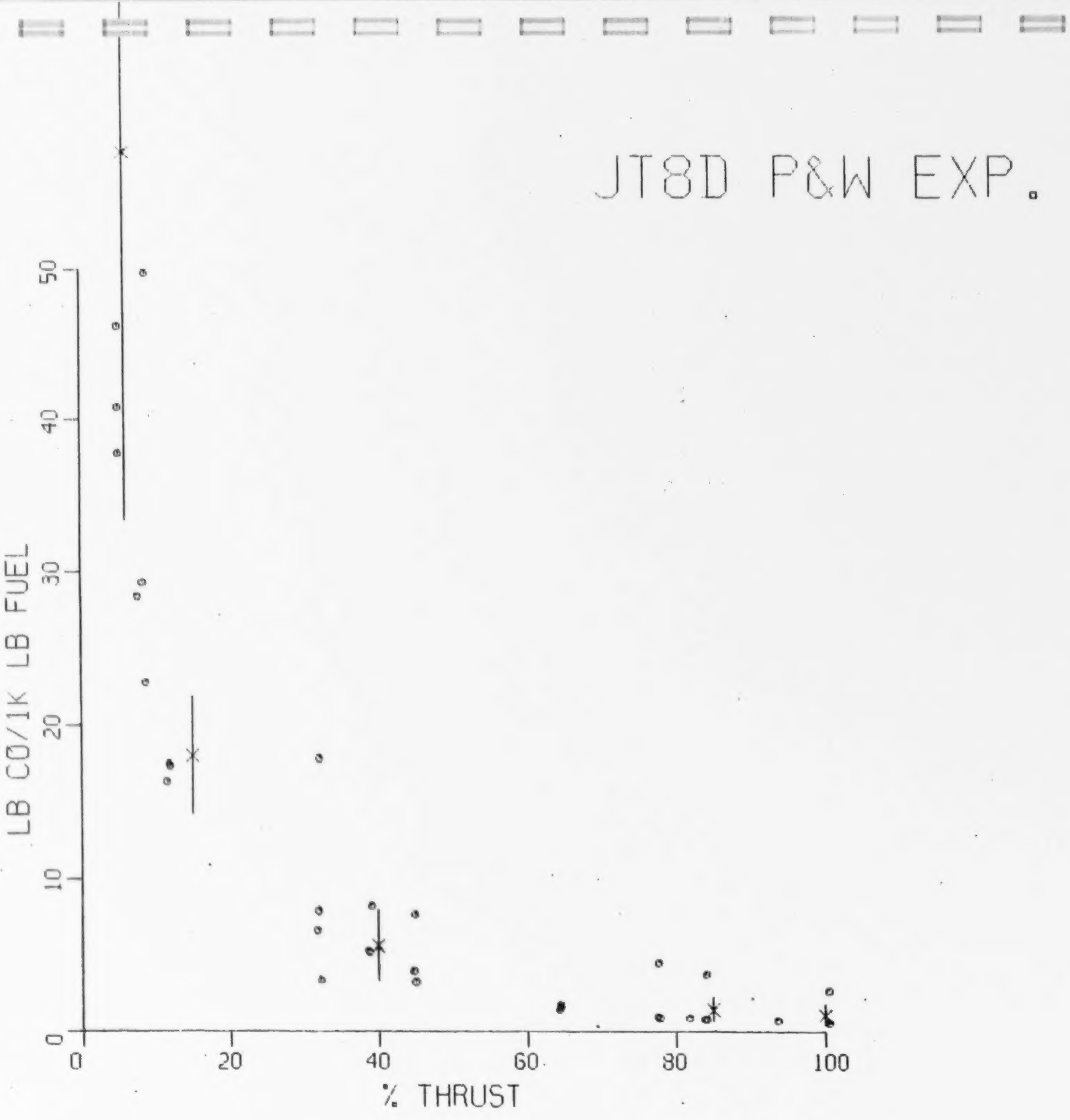



JT8D D-S P&W
LB CO/1K LB FUEL
0
10
20
30
40
50
% THRUST
0
20
40
60
80
100

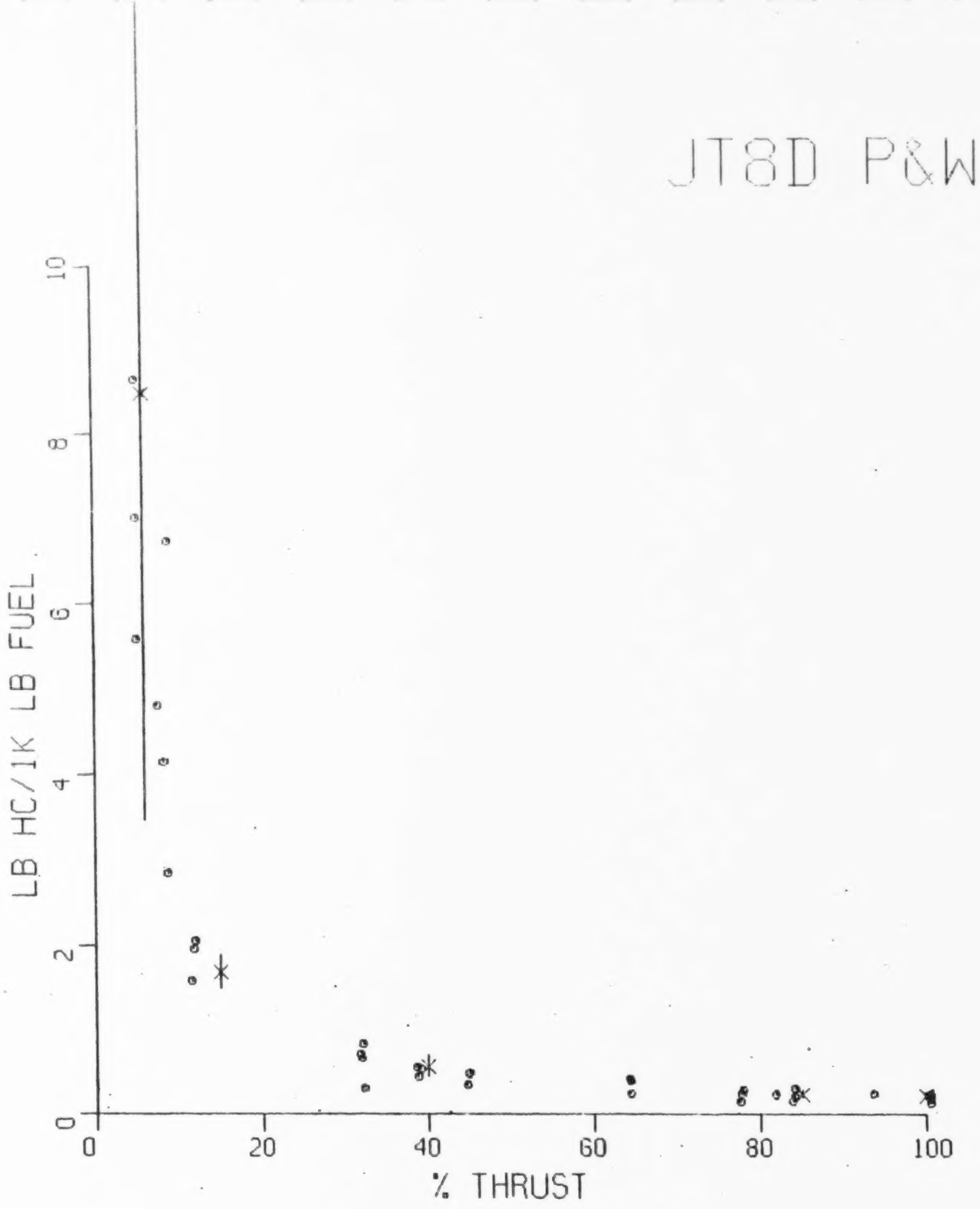
JT8D D-S P&W



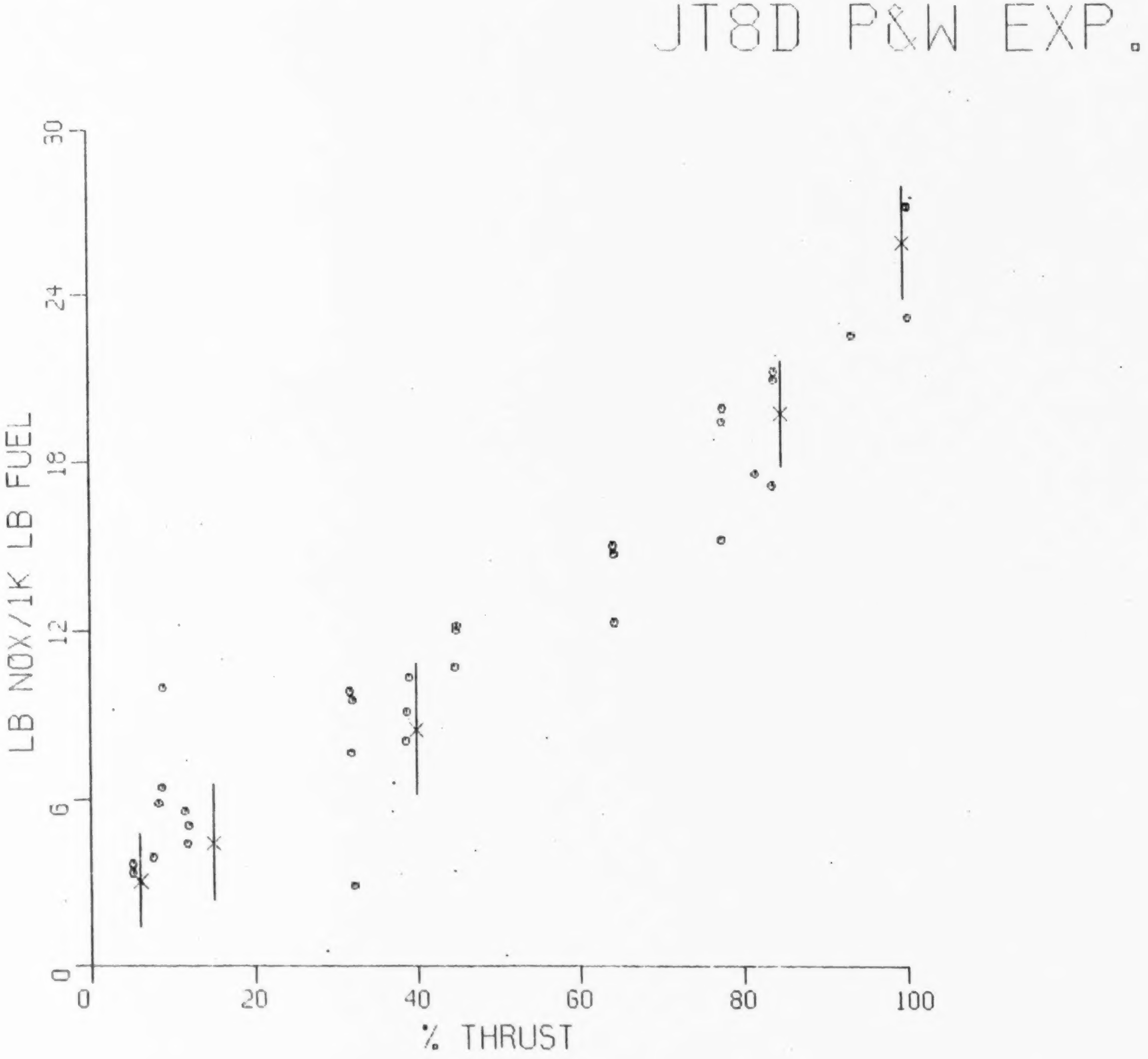

JT8D D-S P&W
LB NOX/1K LB FUEL
0
6
12
18
24
30
0
20
40
60
80
100
% THRUST

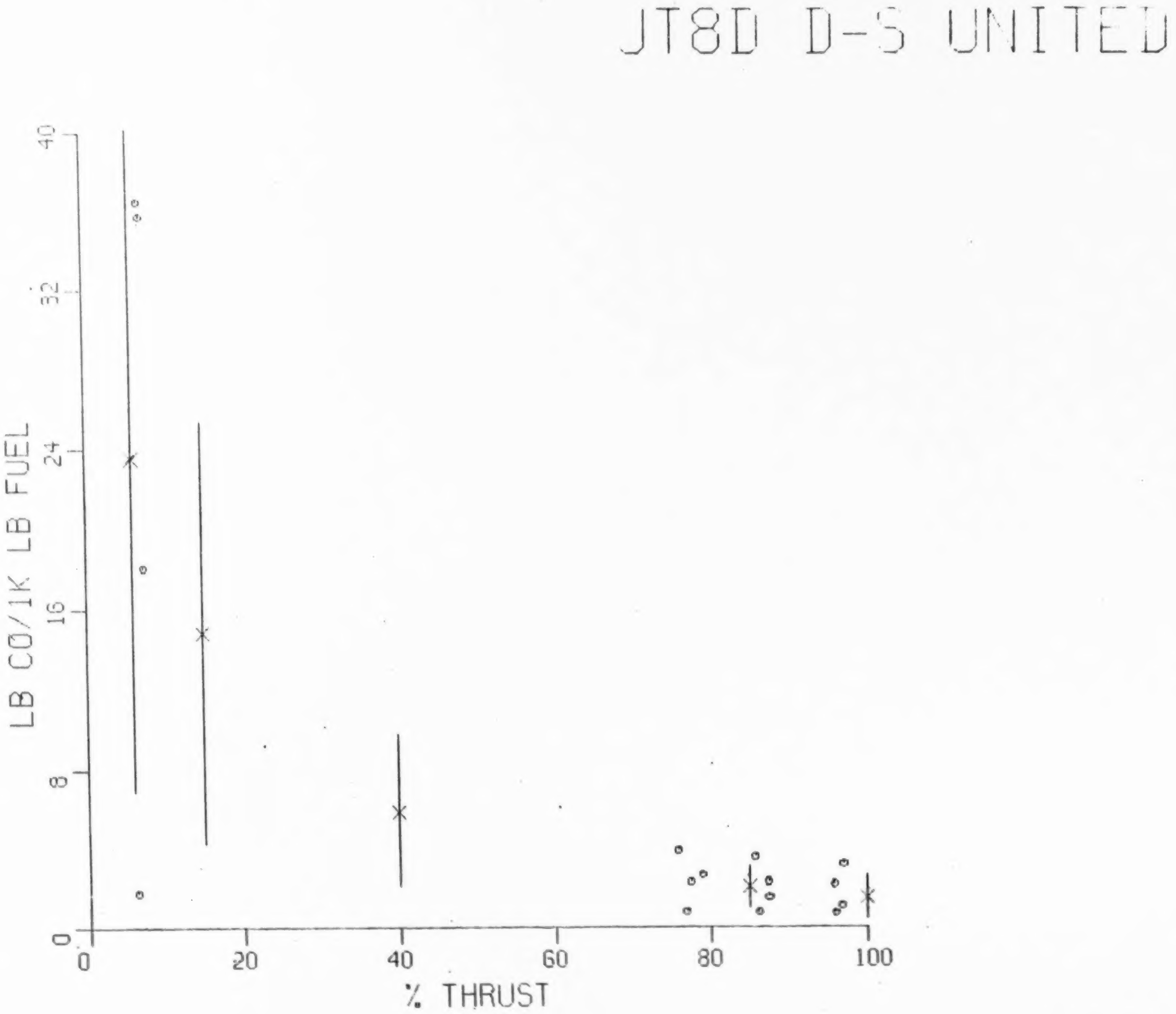


JT8D P&W EXP.

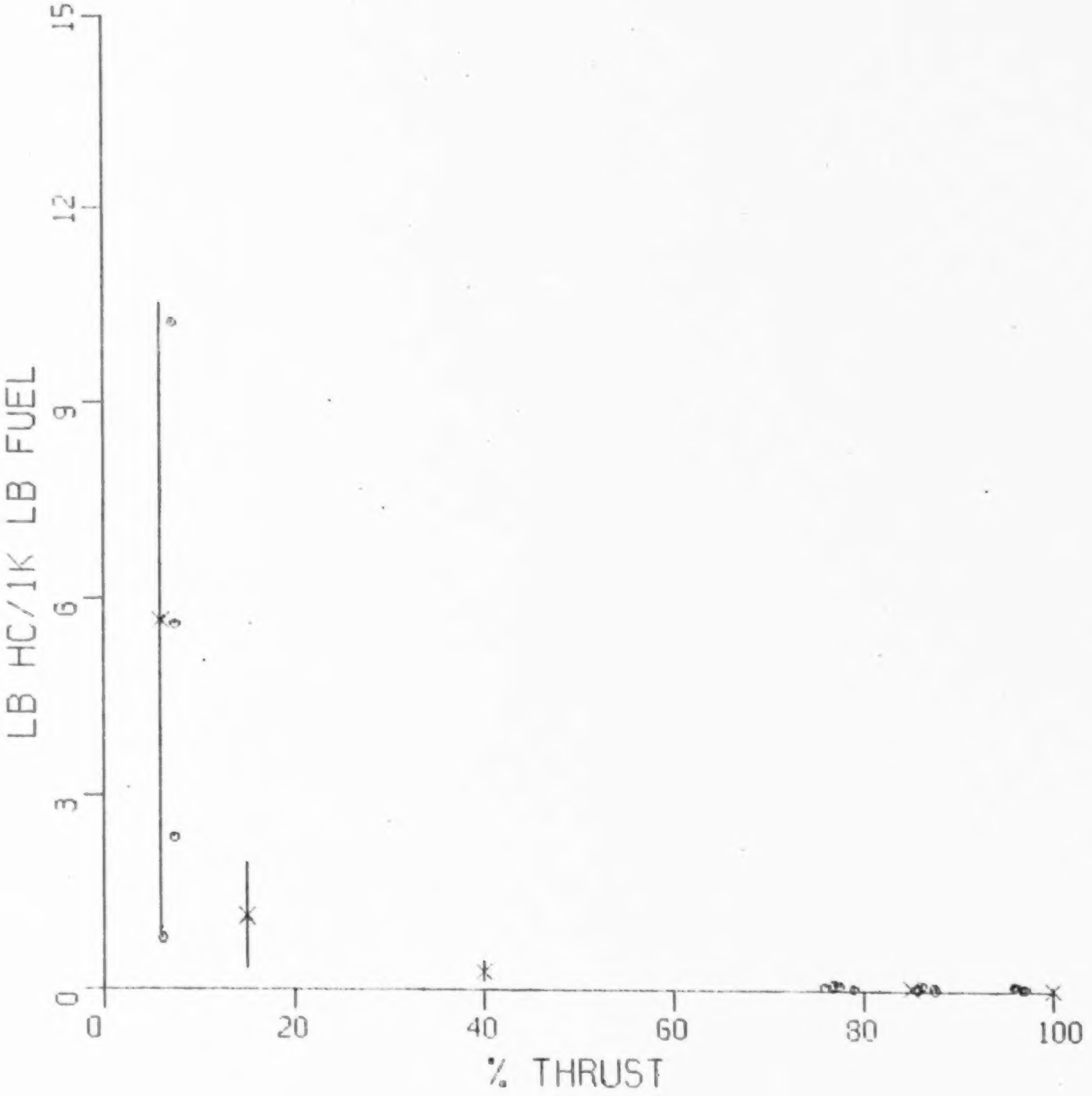


JT8D P&W EXP.

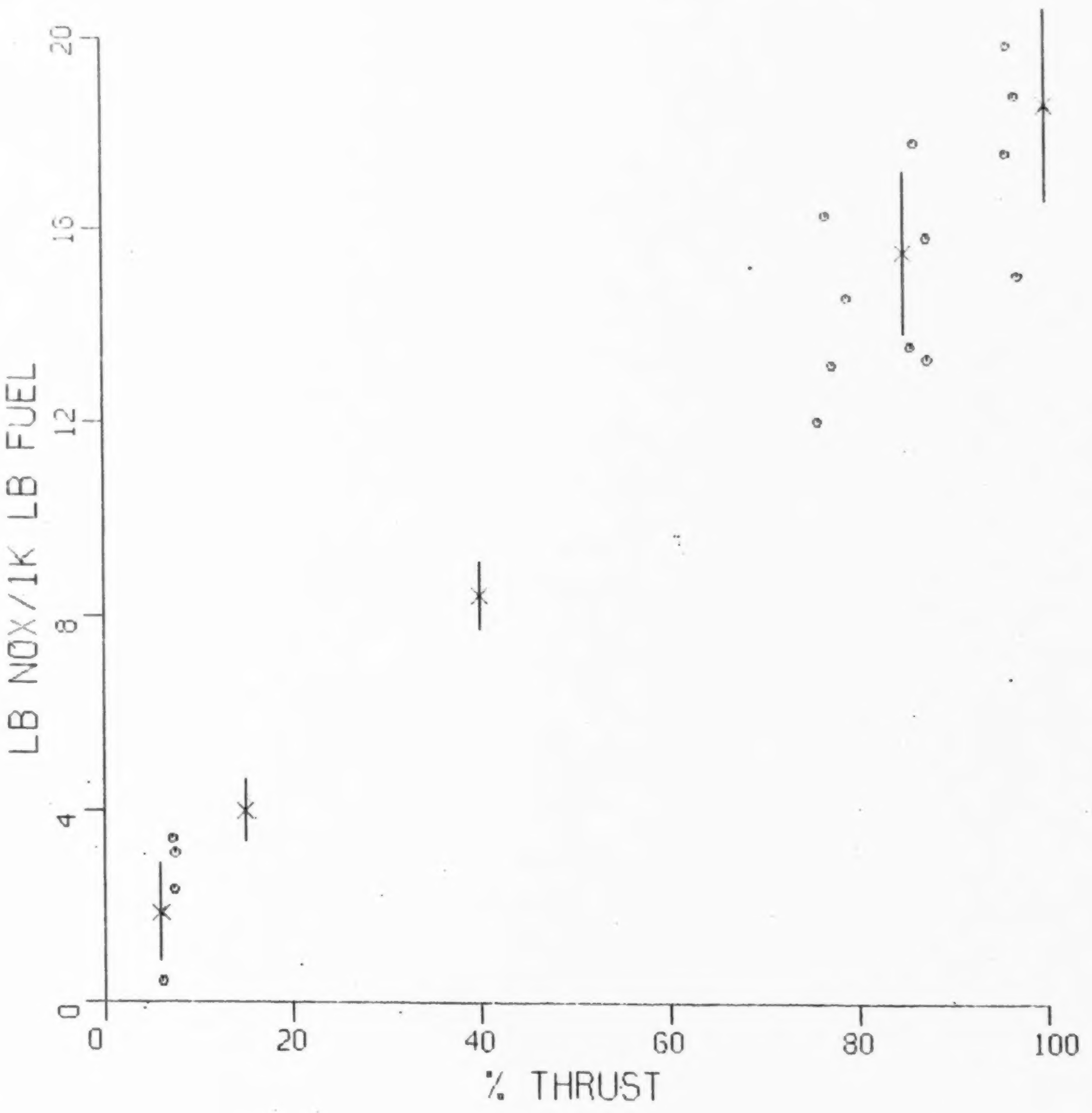

JT8D P&W EXP.
LB NOX/1K LB FUEL
0
6
12
18
24
30
% THRUST
0
20
40
60
80
100


JT8D D-S UNITED
LB CO/1K LB FUEL
0
8
16
24
32
40
0
20
40
60
80
100
% THRUST

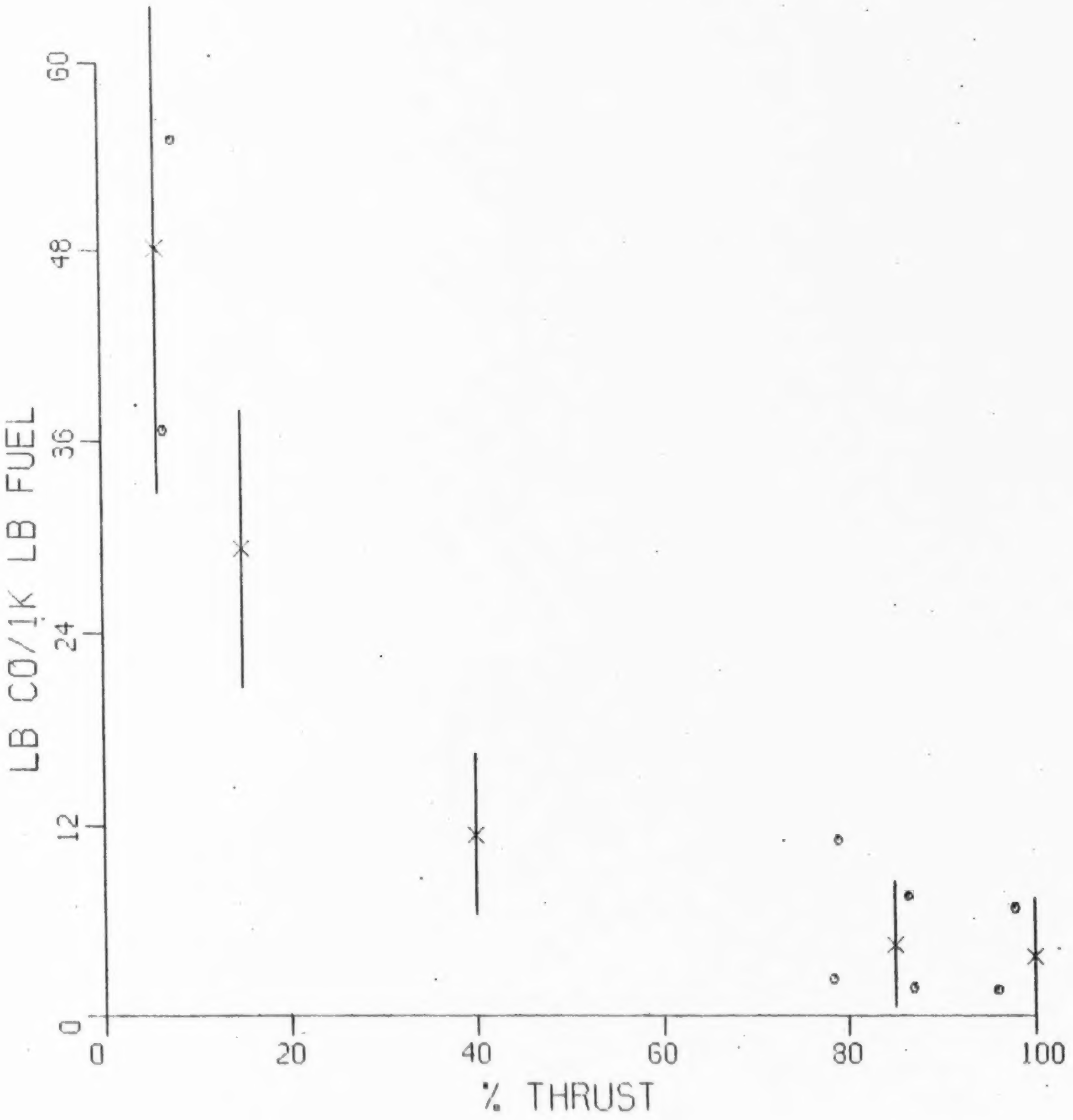
JT8D D-S UNITED



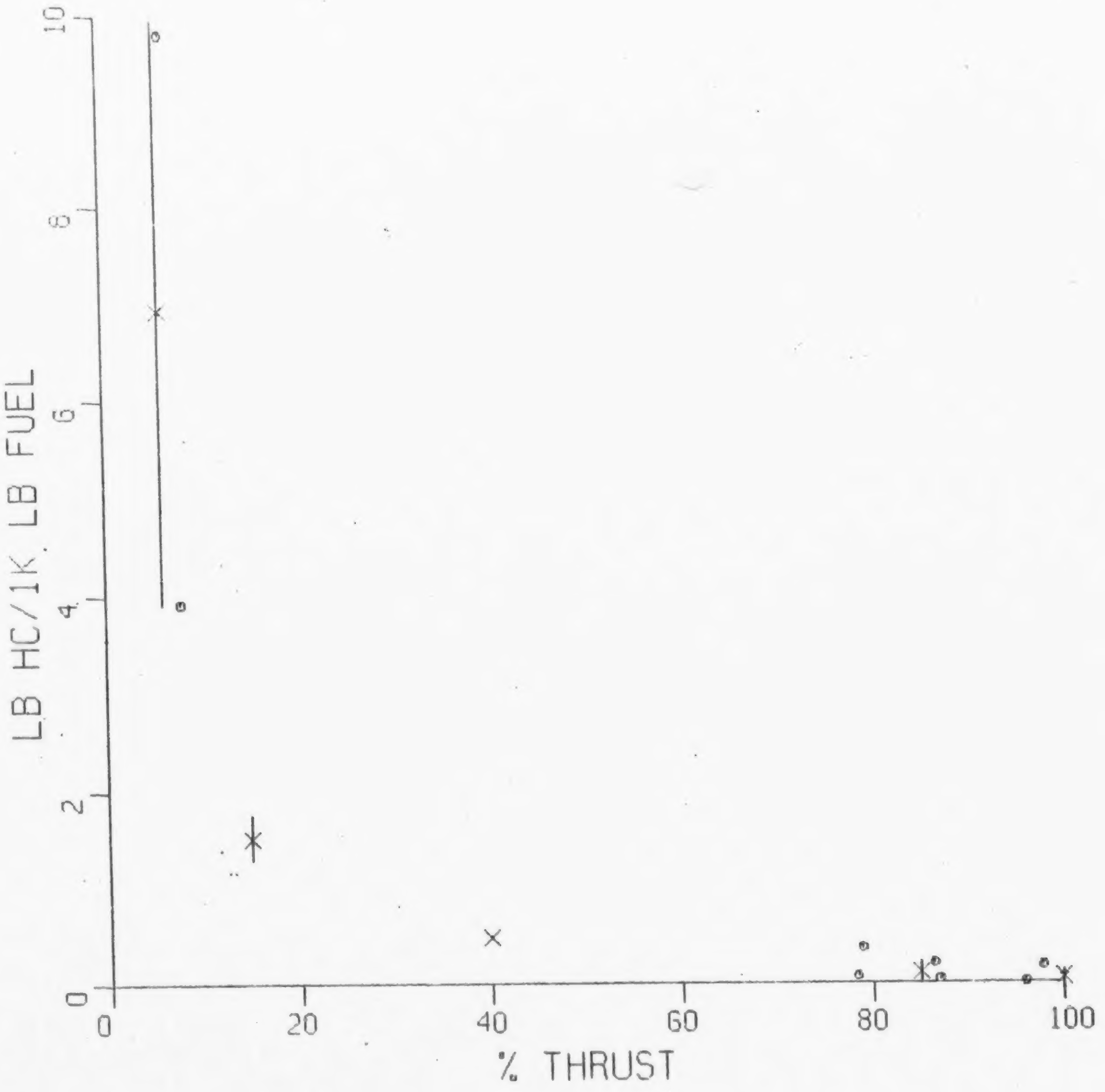
JT8D D-S UNITED



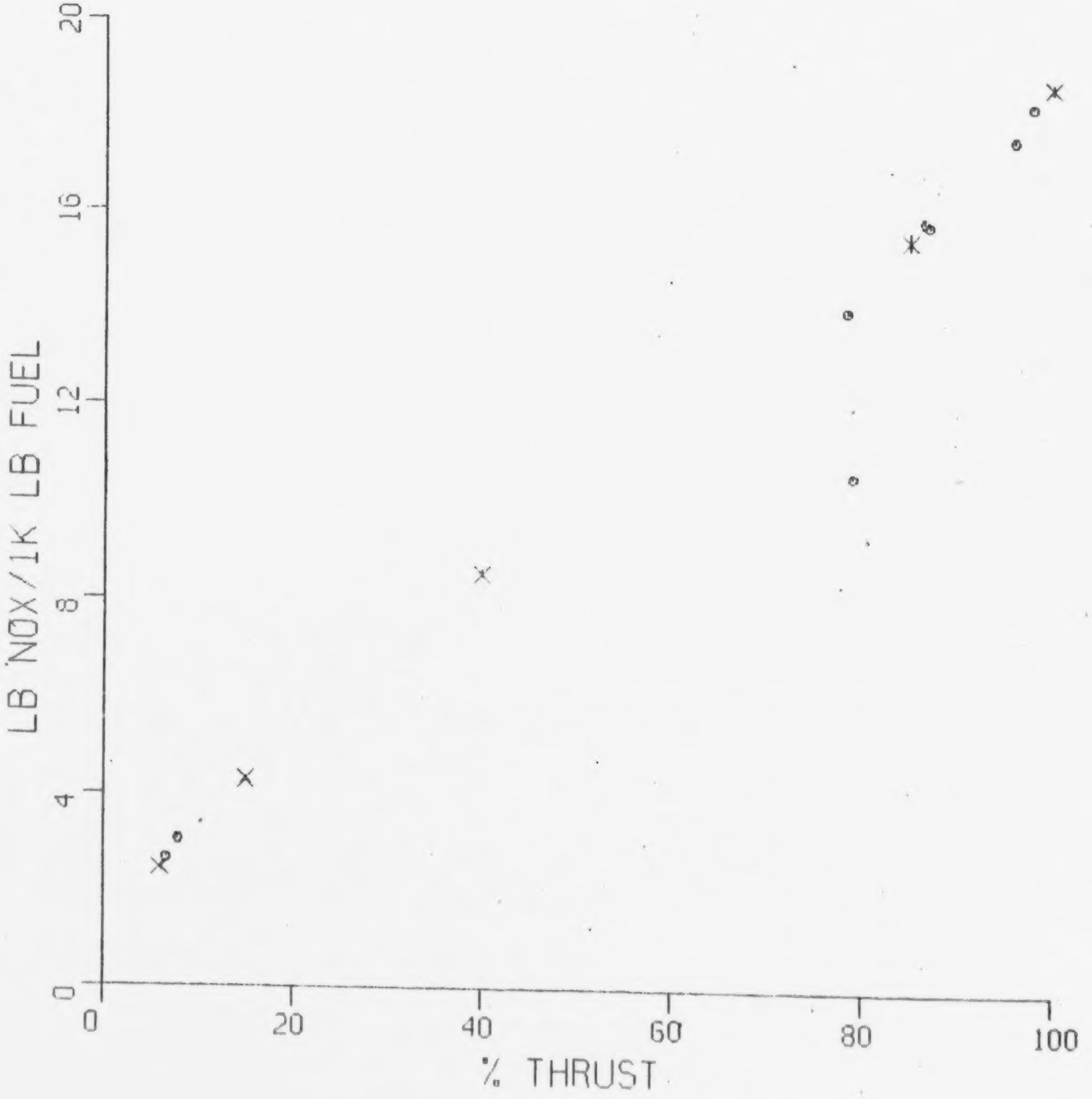
JT8D D-R UNITED

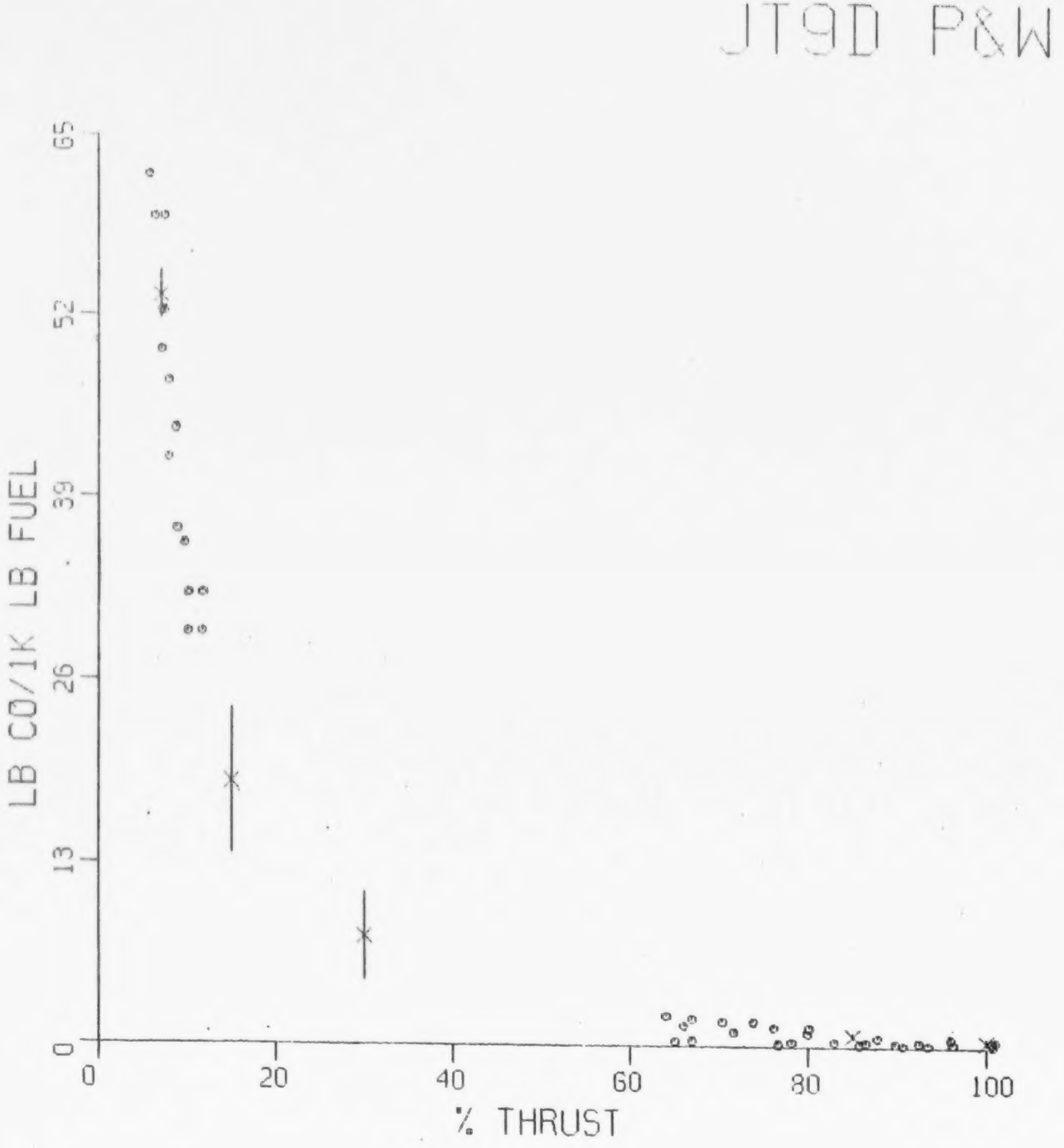


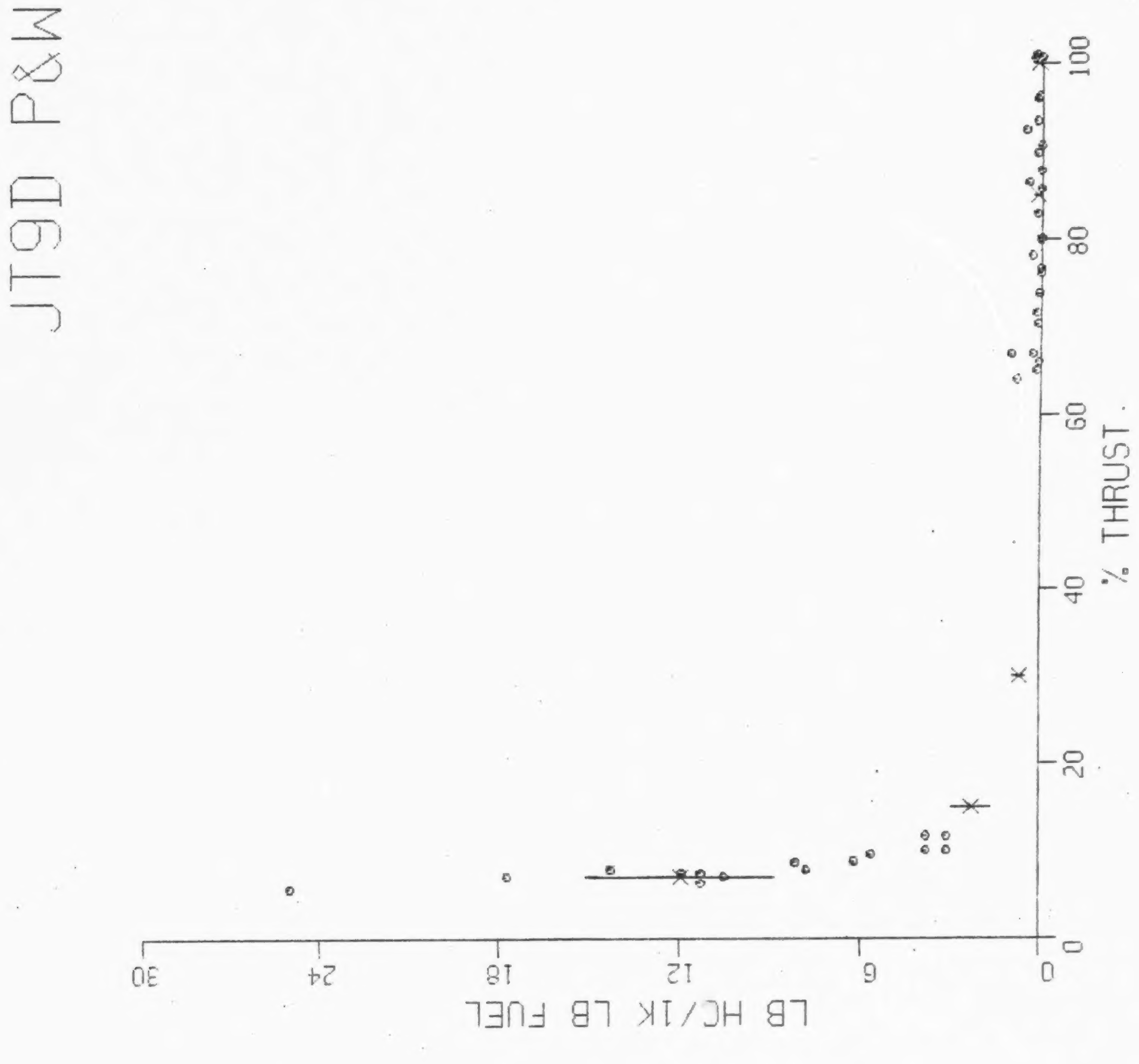
JT8D D-R UNITED

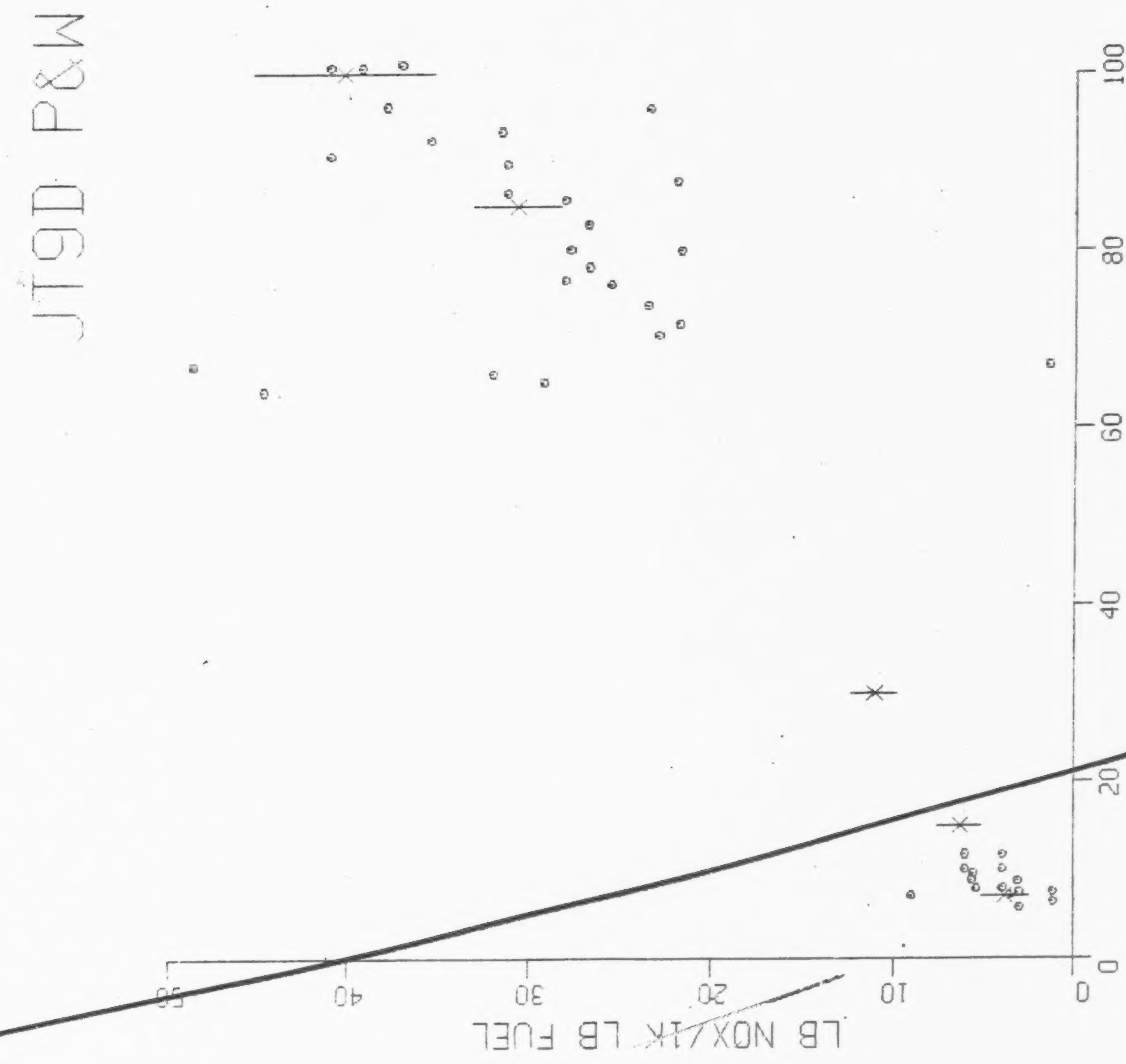


JT8D D-R UNITED

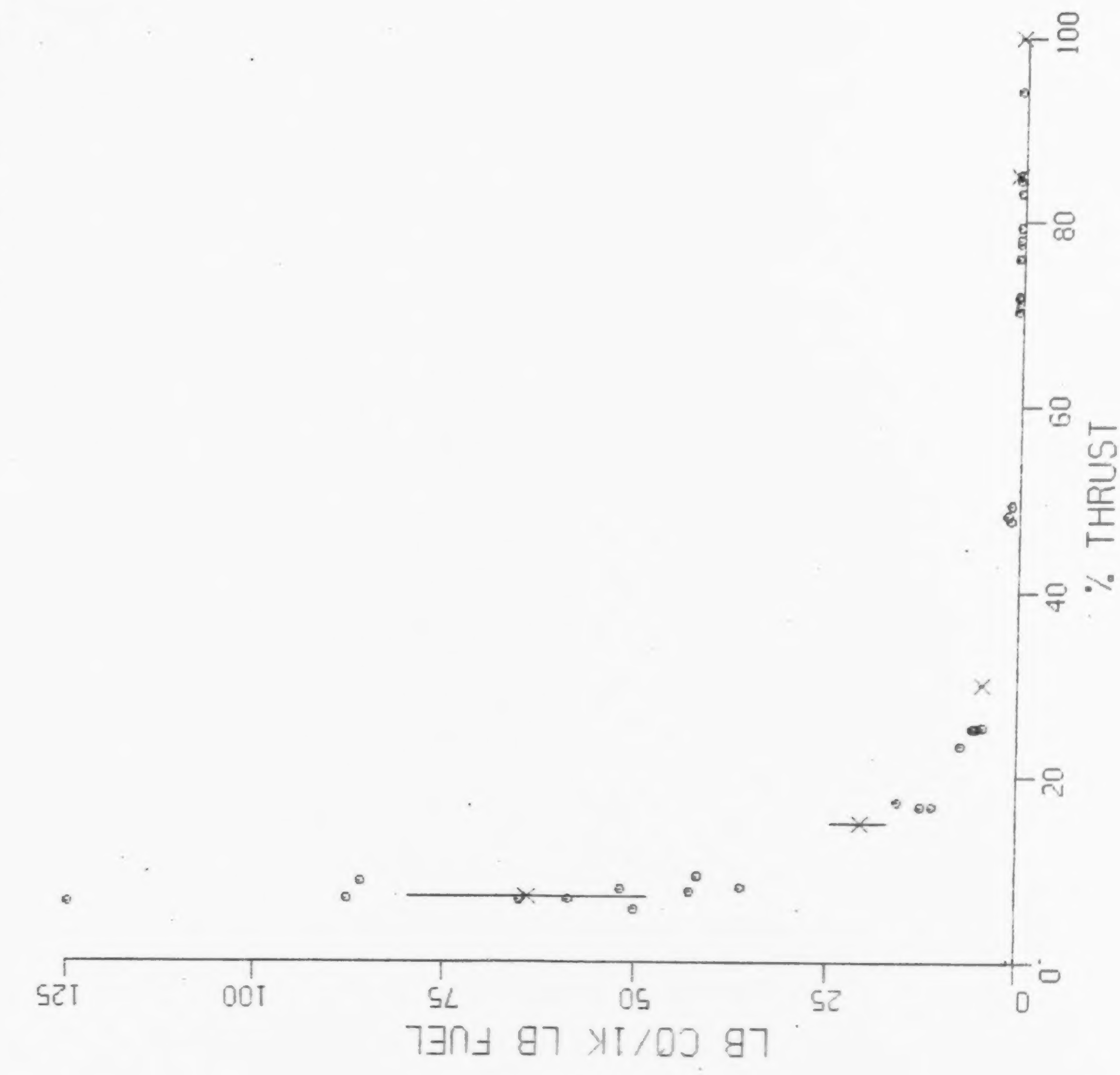


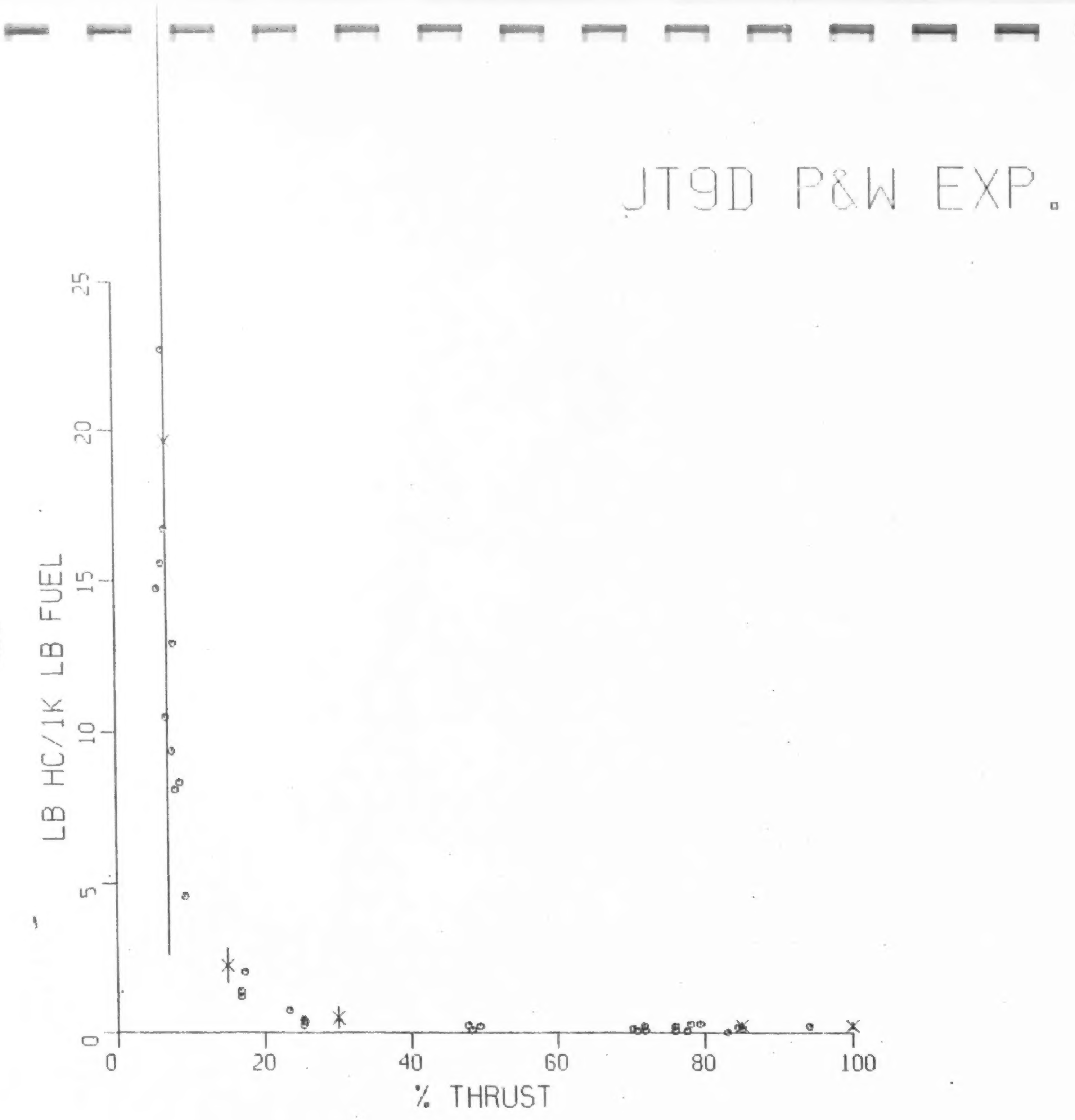

JT9D P&W
LB CO/1K LB FUEL
0
13
26
39
52
65
0
20
40
60
80
100
% THRUST

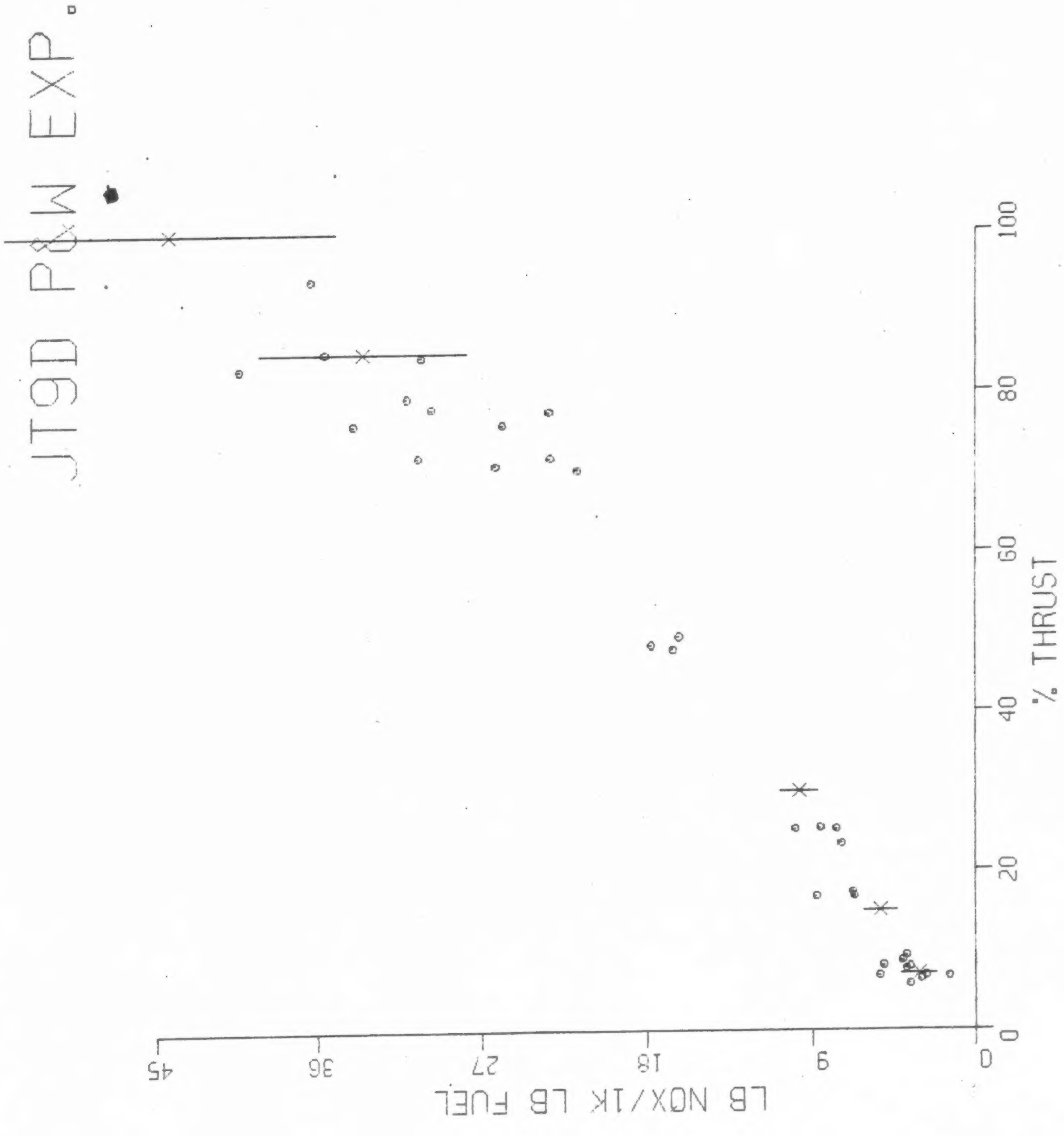

JT9D P&W
LB HC/1K LB FUEL
0
6
12
18
24
30
% THRUST
0
20
40
60
80
100


JT9D P&W
LB NOX/1K LB FUEL
0
10
20
30
40
50
% THRUST
0
20
40
60
80
100

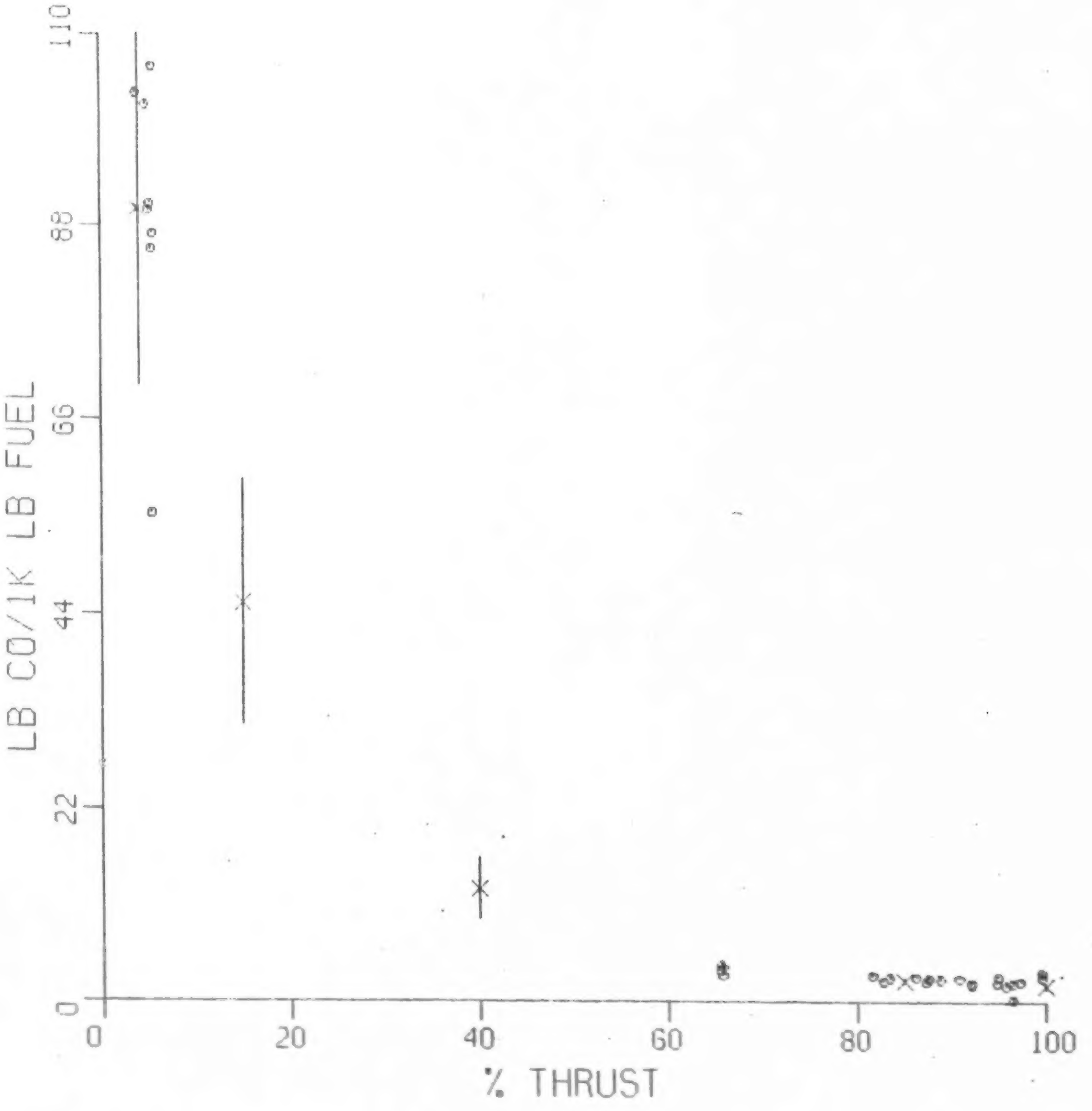
JT9D P&W EXP.



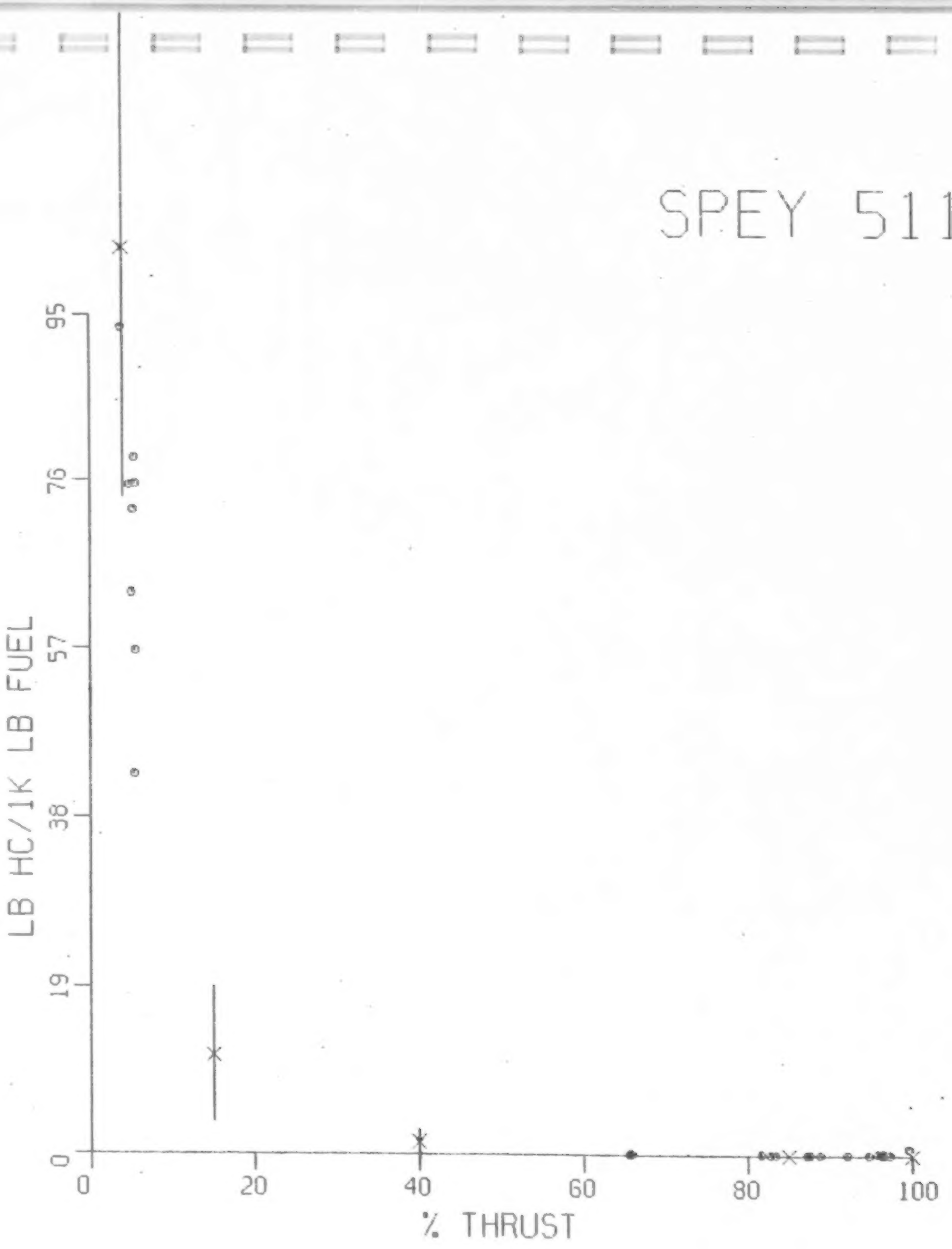

JT9D P&W EXP.
LB HC/1K LB FUEL
0
5
10
15
20
25
% THRUST
0
20
40
60
80
100

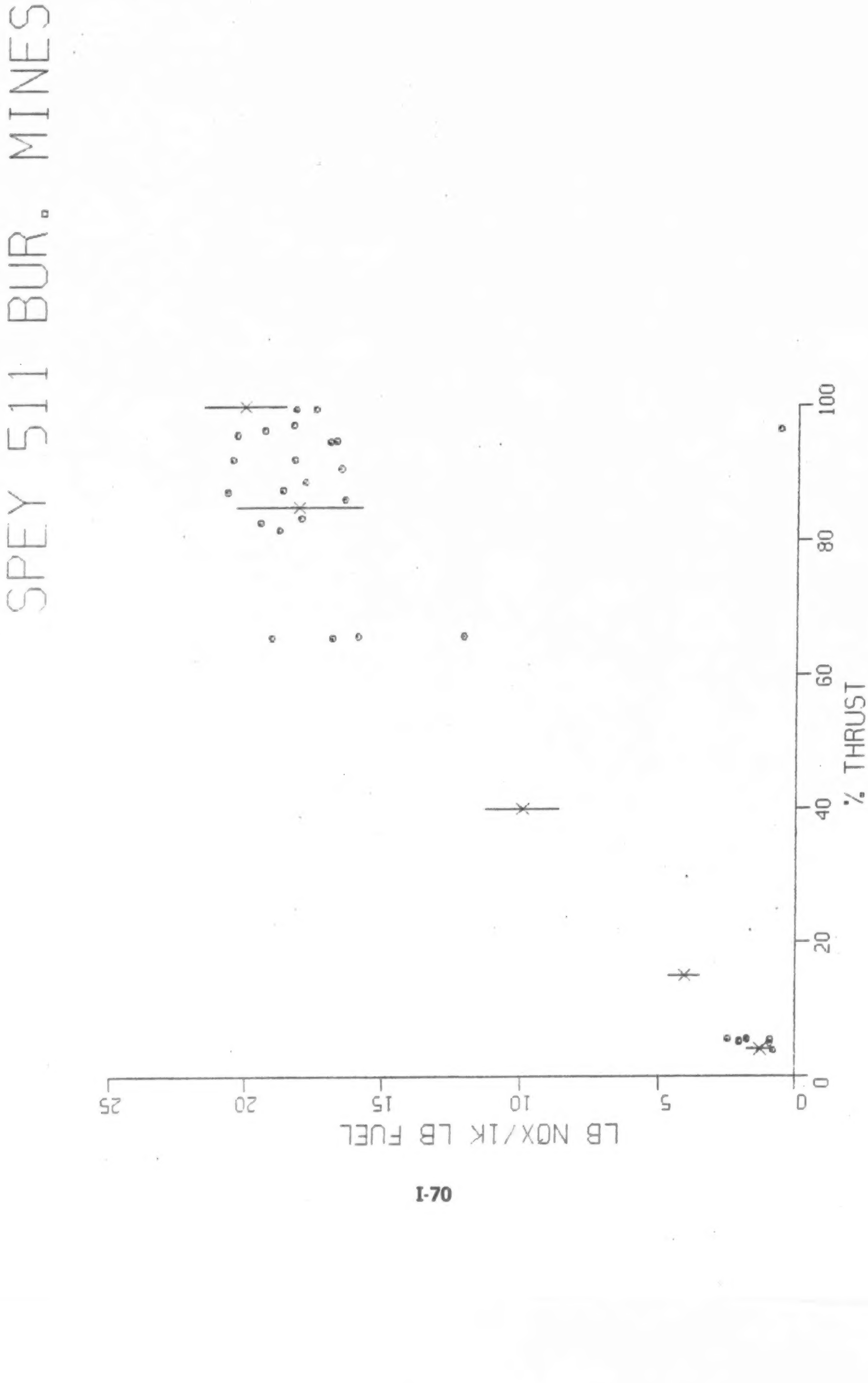

JT9D P&W EXP.
% THRUST
0
20
40
60
80
100
LB NOX/1K LB FUEL
0
9
18
27
36
45

SPEY 511 BUR. MINES



SPEY 511 BUR. MINES




SPEY 511 BUR. MINES
LB NOX/1K LB FUEL
0
5
10
15
20
25
% THRUST
0
20
40
60
80
100

APPENDIX II

ANALYSIS OF VARIANCE FOR PISTON ENGINE EMISSIONS

CONTENTS:

II-2 TO II-4 MODEL Ø-200-A
II-5 TO II-8 MODEL Ø-320
II-9 TO II-10 MODEL IØ-360
II-11 TO II-13 MODEL IØ-470
II-14 TO II-15 MODEL TSIØ-520
II-16 TO II-17 MODEL IØ-540
II-18 TO II-19 MODEL Ø-540

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	10.07	2.01	1138.14	11452.29	2.290	31.06	334.77	0.0670	1.16	11.38	0.0023
	STD DEV:	1.32	0.26	5.83	1444.57	0.289	27.15	331.39	0.0663	0.33	2.15	0.0004
6	MEAN:	50.57	0.25	1147.64	58040.96	0.290	10.58	530.59	0.0027	5.39	272.38	0.0014
	STD DEV:	0.95	0.00	38.05	2545.96	0.013	7.18	350.67	0.0018	0.50	20.65	0.0001
7	MEAN:	50.57	4.20	1147.64	58040.96	4.817	10.58	530.59	0.0440	5.39	272.38	0.0226
	STD DEV:	0.95	0.08	38.05	2545.96	0.211	7.18	350.67	0.0291	0.50	20.65	0.0017
9	MEAN:	22.00	2.20	1079.21	23742.63	2.374	13.24	291.36	0.0291	5.28	116.18	0.0116
	STD DEV:	0.02	0.0	23.61	520.68	0.052	8.74	192.26	0.0192	0.52	11.50	0.0012
10	MEAN:	8.37	0.56	1137.95	9505.93	0.637	19.45	166.40	0.0111	1.55	12.95	0.0009
	STD DEV:	0.46	0.03	49.15	123.42	0.008	11.79	110.73	0.0074	0.07	0.80	0.0001
TOTAL FOR CYCLE	MEAN:		9.224			10.409			0.154			0.0387
	STD DEV:		0.243			0.329			0.124			0.0013
TOTAL FOR CYCLE/LB FUEL	MEAN:					1.128			0.017			0.0042
	STD DEV:					0.016			0.013			0.0001

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.53	1.51	899.67	6772.32	1.354	32.42	245.96	0.0492	1.18	8.85	0.0018
	STD DEV:	0.99	0.20	53.88	934.00	0.187	3.00	51.53	0.0103	0.26	2.25	0.0005
6	MEAN:	49.60	0.25	1148.18	56949.66	0.285	15.01	744.49	0.0037	3.52	174.69	0.0009
	STD DEV:	0.0	0.0	45.38	2252.31	0.011	3.60	178.44	0.0009	0.56	27.90	0.0001
7	MEAN:	49.60	4.12	1148.18	56949.66	4.727	15.01	744.49	0.0618	3.52	174.69	0.0145
	STD DEV:	0.0	0.0	45.38	2252.31	0.187	3.60	178.44	0.0148	0.56	27.90	0.0023
9	MEAN:	21.10	2.11	1160.00	24481.35	2.448	17.44	367.75	0.0368	1.87	39.22	0.0039
	STD DEV:	0.90	0.09	12.53	1241.69	0.124	1.09	23.77	0.0024	0.25	3.51	0.0004
10	MEAN:	5.87	0.39	936.28	5482.92	0.367	20.99	123.61	0.0083	1.29	7.64	0.0005
	STD DEV:	0.46	0.03	61.97	376.62	0.025	2.40	21.43	0.0014	0.15	1.59	0.0001
TOTAL FOR CYCLE	MEAN:		8.175			9.182			0.160			0.0216
	STD DEV:		0.222			0.381			0.005			0.0029
TOTAL FOR CYCLE/LB FUEL	MEAN:					1.096			0.019			0.0026
	STD DEV:					0.018			0.001			0.0006

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.50	1.50	1023.33	7693.66	1.539	25.36	189.86	0.0380	0.94	5.24	0.0012
	STD DEV:	0.52	0.10	62.49	978.99	0.195	4.19	29.99	0.0060	0.19	1.05	0.0002
6	MEAN:	49.93	0.25	1156.57	57763.96	0.289	15.47	772.53	0.0039	6.96	347.92	0.0017
	STD DEV:	0.58	0.00	56.33	3244.19	0.016	1.47	70.63	0.0006	1.43	70.73	0.0004
7	MEAN:	49.93	4.14	1156.57	57763.96	4.796	15.47	772.53	0.0641	6.96	347.92	0.0288
	STD DEV:	0.58	0.05	56.33	3244.19	0.264	1.47	70.63	0.0053	1.43	70.73	0.0059
9	MEAN:	22.30	2.23	1167.82	26035.31	2.604	17.31	385.42	0.0385	1.54	44.63	0.0036
	STD DEV:	0.52	0.05	26.37	409.09	0.060	2.19	42.63	0.0043	0.16	3.64	0.0004
10	MEAN:	6.67	0.45	1027.96	6867.73	0.452	21.93	144.55	0.0097	1.23	7.27	0.0005
	STD DEV:	0.46	0.03	49.15	453.11	0.031	4.93	27.05	0.0018	0.14	0.65	0.0000
TOTAL FOR CYCLE	MEAN:		8.571			9.684			0.154			0.0354
	STD DEV:		0.248			0.444			0.017			0.0059
TOTAL FOR CYCLE/LB FUEL	MEAN:					1.130			0.018			0.0042
	STD DEV:					0.022			0.002			0.0007

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.20	1.44	911.05	5930.58	1.164	22.92	165.00	0.0330	1.42	10.20	0.0029
	STD DEV:	0.01	0.10	77.29	666.43	0.111	4.11	29.56	0.0059	0.54	4.15	0.0009
6	MEAN:	42.07	0.21	793.89	36594.10	0.183	11.04	502.78	0.0025	15.93	563.49	0.0027
	STD DEV:	9.21	0.05	533.38	27041.00	0.135	6.62	339.49	0.0017	21.38	653.43	0.0033
7	MEAN:	42.07	3.50	793.89	36594.10	3.037	11.04	502.78	0.0417	15.93	563.49	0.0463
	STD DEV:	9.21	0.76	533.38	27041.00	2.244	6.44	339.49	0.0282	21.38	653.43	0.0543
9	MEAN:	20.23	2.02	1063.36	21715.14	2.172	17.05	345.29	0.0345	1.82	35.67	0.0036
	STD DEV:	2.32	0.23	124.95	4934.22	0.493	3.25	43.71	0.0044	0.72	9.43	0.0013
10	MEAN:	6.13	0.41	867.90	5325.94	0.357	18.14	111.78	0.0075	2.13	13.04	0.0004
	STD DEV:	0.46	0.03	55.74	571.95	0.039	2.35	20.95	0.0014	0.75	4.90	0.0003
TOTAL FOR CYCLE	MEAN:		7.576			6.917			0.119			0.0563
	STD DEV:		1.235			2.974			0.039			0.0588
TOTAL FOR CYCLE/LB FUEL	MEAN:					0.887			0.015			0.0083
	STD DEV:					0.295			0.003			0.0095

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	6.70	1.34	1020.08	6937.36	1.387	28.90	199.06	0.0398	0.98	6.16	0.0012
	STD DEV:	1.28	0.26	121.66	2154.10	0.431	6.37	81.90	0.0164	0.49	2.34	0.0005
6	MEAN:	49.27	0.25	1178.01	58062.27	0.290	18.94	933.49	0.0047	3.13	154.02	0.0008
	STD DEV:	0.58	0.00	67.94	3999.62	0.020	1.50	83.80	0.0004	0.78	36.57	0.0002
7	MEAN:	49.27	4.09	1178.01	58062.27	4.819	18.94	933.49	0.0775	3.13	154.02	0.0128
	STD DEV:	0.58	0.05	67.94	3999.62	0.332	1.50	83.80	0.0070	0.78	36.57	0.0030
9	MEAN:	20.50	2.05	1100.51	22560.21	2.256	20.37	417.18	0.0417	2.00	41.01	0.0041
	STD DEV:	1.04	0.10	3.54	1143.19	0.114	0.70	16.02	0.0016	0.19	5.64	0.0006
10	MEAN:	5.57	0.37	1065.25	5941.67	0.398	24.15	135.46	0.0091	1.09	6.07	0.0004
	STD DEV:	0.85	0.06	44.44	1065.25	0.071	1.93	31.20	0.0021	0.12	0.98	0.0001
TOTAL FOR CYCLE		MEAN:	8.098			9.151			0.173			0.0193
		STD DEV:	0.412			0.862			0.026			0.0030
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.129			0.021			0.0024
					STD DEV:	0.053			0.002			0.0005

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.23	1.45	1007.91	7272.62	1.455	26.04	186.14	0.0372	1.32	9.70	0.0019
	STD DEV:	0.85	0.17	44.73	657.98	0.132	4.26	11.78	0.0024	0.35	3.54	0.0007
6	MEAN:	49.27	0.25	1199.80	59143.56	0.296	18.09	891.78	0.0045	2.00	98.17	0.0005
	STD DEV:	0.58	0.00	86.74	4935.68	0.025	1.48	83.08	0.0004	0.53	24.78	0.0001
7	MEAN:	49.27	4.09	1199.80	59143.56	4.909	18.09	891.78	0.0740	2.00	98.17	0.0081
	STD DEV:	0.58	0.05	86.74	4935.68	0.410	1.48	83.08	0.0069	0.53	24.78	0.0021
9	MEAN:	21.40	2.14	1142.20	24451.75	2.445	20.28	434.22	0.0434	2.36	50.35	0.0050
	STD DEV:	0.52	0.05	25.70	1147.38	0.115	1.12	32.10	0.0032	0.34	6.24	0.0006
10	MEAN:	6.67	0.45	1038.62	6883.65	0.461	24.80	161.60	0.0108	1.40	9.50	0.0006
	STD DEV:	0.92	0.06	65.77	556.79	0.037	6.06	14.33	0.0010	0.34	3.34	0.0002
TOTAL FOR CYCLE		MEAN:	8.369			9.566			0.170			0.0163
		STD DEV:	0.224			0.490			0.004			0.0012
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.143			0.020			0.0019
					STD DEV:	0.031			0.000			0.0002

MODEL SUMMARY SAMPLE NUMBER = 18.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.71	1.54	983.36	7661.30	1.532	27.79	220.13	0.0440	1.15	8.75	0.0018
	STD DEV:	1.37	0.27	121.72	2115.38	0.423	10.51	132.90	0.0266	0.38	3.09	0.0006
6	MEAN:	48.45	0.24	1104.02	54425.75	0.272	14.85	729.28	0.0036	6.15	264.61	0.0013
	STD DEV:	4.36	0.02	237.51	12694.16	0.063	4.90	249.82	0.0012	3.78	271.79	0.0014
7	MEAN:	48.45	4.02	1104.02	54425.75	4.517	14.85	729.28	0.0605	6.15	264.61	0.0220
	STD DEV:	4.36	0.36	237.51	12694.16	1.054	4.90	249.82	0.0207	3.78	271.79	0.0226
9	MEAN:	21.26	2.13	1118.85	23831.07	2.383	17.61	373.53	0.0374	2.48	52.83	0.0053
	STD DEV:	1.23	0.12	62.45	2341.14	0.234	3.99	85.76	0.0086	1.36	30.28	0.0030
10	MEAN:	6.54	0.44	1012.32	6664.61	0.447	21.56	140.57	0.0094	1.53	9.41	0.0006
	STD DEV:	1.08	0.07	101.27	1531.55	0.103	5.59	46.62	0.0031	0.47	3.56	0.0002
TOTAL FOR CYCLE		MEAN:	8.369			9.151			0.155			0.0309
		STD DEV:	0.657			1.565			0.049			0.0245
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.085			0.018			0.0039
					STD DEV:	0.133			0.005			0.0039

```
                                        ANALYSIS OF VARIANCE

      WITHIN DEGREES OF FREEDOM =   5                   BETWEEN DEGREES OF FREEDOM =  12                        0-200-A

TEST              MEASURED   FUEL      CO          CO          CO        HC        HC        HC          NO        NO        NO
MODE              FUEL FLOW  USED     LB/1K       LB/1K     EMISSION    LB/1K     LB/1K    EMISSION     LB/1K     LB/1K    EMISSION
                   LB/HR     LBS.    LB FUEL      HOURS       LBS.     LB FUEL    HOURS      LBS.      LB FUEL    HOURS      LBS.


  2    MS AMONG:    4.28     0.17   38524.40 11494259.00  0.4598      39.67   11618.67   0.000465     0.14      13.75    0.000001
      MS WITHIN:    0.89     0.04    4936.16  1550053.00  0.0620     139.87   20182.41   0.000807     0.15       7.67    0.000000
        F RATIO:    4.82     4.82       7.80        7.42  7.4152       0.28       0.58   0.575689     0.90       1.79    1.793472
     VAR. AMONG:    1.13     0.05   11196.08  3314735.00  0.1326     -33.40   -2854.58  -0.000114    -0.00       2.03    0.000000
     VAR. COMB.:    2.02     0.08   16132.24  4864798.00  0.1946     106.47   17327.83   0.000693     0.15       9.70    0.000000
       R INTRA:     0.56     0.56       0.69        0.68  0.6814      -0.31      -0.16  -0.164737    -0.03       0.21    0.209168
     SIG COMB.:     1.42     0.28     127.01     2205.63  0.4411      10.32     131.64   0.026327     0.38       3.11    0.000623

  6    MS AMONG:   30.06     0.00   70468.00230418528.00  0.0058      36.25   96596.50   0.000002    77.75   78672.88    0.000002
      MS WITHIN:   14.45     0.00   50551.66132276352.00  0.0033      18.85   48163.45   0.000001    76.76   71870.50    0.000002
        F RATIO:    2.08     2.08       1.39        1.74  1.7420       1.92       2.01   2.005642     1.01       1.09    1.094644
     VAR. AMONG:    5.20     0.00    6638.78 32714048.00  0.0008       5.80   16144.35   0.000000     0.33    2267.46    0.000000
     VAR. COMB.:   19.66     0.00   57190.44164990400.00  0.0041      24.65   64307.80   0.000002    77.09   74137.94    0.000002
       R INTRA:     0.26     0.26       0.12        0.20  0.1983       0.24       0.25   0.251056     0.00       0.03    0.030583
     SIG COMB.:     4.43     0.02     239.15    12844.86  0.0642       4.96     253.59   0.001268     8.78     272.28    0.001361

  7    MS AMONG:   30.06     0.21   70468.00230418528.00  1.5874      36.25   96596.50   0.000665    77.75   78672.88    0.000542
      MS WITHIN:   14.45     0.10   50551.66132276352.00  0.9112      18.85   48163.45   0.000332    76.76   71870.50    0.000495
        F RATIO:    2.08     2.08       1.39        1.74  1.7420       1.92       2.01   2.005562     1.01       1.09    1.094646
     VAR. AMONG:    5.20     0.04    6638.78 32714048.00  0.2254       5.80   16144.35   0.000111     0.33    2267.46    0.000016
     VAR. COMB.:   19.66     0.14   57190.44164990400.00  1.1366      24.65   64307.80   0.000443    77.09   74137.94    0.000511
       R INTRA:     0.26     0.26       0.12        0.20  0.1983       0.24       0.25   0.251041     0.00       0.03    0.030584
     SIG COMB.:     4.43     0.37     239.15    12844.86  1.0661       4.96     253.59   0.021048     8.78     272.28    0.022599

  9    MS AMONG:    1.99     0.02    5776.00  7058073.00  0.0706      20.53    7987.39   0.000080     5.87    2987.44    0.000030
      MS WITHIN:    1.31     0.01    3118.67  4823786.00  0.0482      14.02    7090.84   0.000071     0.17      54.21    0.000001
        F RATIO:    1.52     1.52       1.85        1.46  1.4644       1.44       1.13   1.126380    34.07      55.11   55.114685
     VAR. AMONG:    0.23     0.00     885.78   744762.31  0.0075       2.17     298.85   0.000003     1.90     977.74    0.000010
     VAR. COMB.:    1.53     0.02    4004.44  5568548.00  0.0557      16.19    7389.68   0.000074     2.07    1031.95    0.000010
       R INTRA:     0.15     0.15       0.22        0.13  0.1340       0.13       0.04   0.040424     0.92       0.95    0.947474
     SIG COMB.:     1.24     0.12      63.28     2359.78  0.2360       4.02      85.96   0.008596     1.44      32.12    0.003212

 10    MS AMONG:    2.96     0.01   27699.60  7119676.00  0.0320      20.22    1360.63   0.000006     0.45      26.72    0.000000
      MS WITHIN:    0.41     0.00    2987.83   356476.00  0.0016      35.83    2511.80   0.000011     0.13       6.61    0.000000
        F RATIO:    7.31     7.31       9.27       19.97 19.9699       0.56       0.54   0.541730     3.55       4.04    4.039927
     VAR. AMONG:    0.85     0.00    8237.25  2254400.00  0.0101      -5.20    -383.72  -0.000002     0.11       6.70    0.000000
     VAR. COMB.:    1.26     0.01   11225.09  2610876.00  0.0117      30.63    2128.07   0.000010     0.23      13.32    0.000000
       R INTRA:     0.69     0.68       0.73        0.86  0.8634      -0.17      -0.18  -0.180298     0.46       0.50    0.503305
     SIG COMB.:     1.12     0.08     105.95     1615.82  0.1083       5.53      46.13   0.003091     0.48       3.65    0.000244

TOTAL FOR CYCLE    MS AMONG:   0.884                          4.2197                         0.001104                          0.000634
                  MS WITHIN:   0.243                          1.7135                         0.002967                          0.000586
                    F RATIO:   3.644                          2.4627                         0.372262                          1.082578
                 VAR. AMONG:   0.214                          0.8354                        -0.000621                          0.000016
                 VAR. COMB.:   0.456                          2.5489                         0.002346                          0.000602
                   R INTRA:    0.468                          0.3278                        -0.264616                          0.026820
                  SIG COMB.:   0.675                          1.5965                         0.048434                          0.024532

TOTAL FOR CYCLE/LB FUEL
                                             MS AMONG:        0.0291                         0.000015                          0.000015
                                            MS WITHIN:        0.0153                         0.000031                          0.000015
                                              F RATIO:        1.9073                         0.477673                          0.968625
                                           VAR. AMONG:        0.0046                        -0.000005                         -0.000000
                                           VAR. COMB.:        0.0199                         0.000026                          0.000015
                                             R INTRA:         0.2322                        -0.210813                         -0.010569
                                            SIG COMB.:        0.1409                         0.005063                          0.003885
```

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	7.80	1.56	608.37	4780.75	0.956	19.57	152.72	0.0305	1.10	8.52	0.0017
	STD DEV:	0.52	0.10	123.48	1219.80	0.244	0.71	13.54	0.0027	0.21	1.39	0.0003
6	MEAN:	69.63	0.35	1213.75	84523.88	0.423	51.94	3609.56	0.0180	0.83	57.99	0.0003
	STD DEV:	0.58	0.00	20.88	2071.37	0.010	25.55	1757.54	0.0088	0.40	28.28	0.0001
7	MEAN:	69.63	5.78	1213.75	84523.88	7.015	51.94	3609.56	0.2996	0.83	57.99	0.0048
	STD DEV:	0.58	0.05	20.88	2071.37	0.172	25.55	1757.54	0.1459	0.40	28.28	0.0023
9	MEAN:	19.90	1.99	1040.78	20720.46	2.072	21.56	429.65	0.0430	1.31	25.97	0.0026
	STD DEV:	1.04	0.10	14.61	1352.69	0.135	1.13	42.24	0.0042	0.05	0.87	0.0001
10	MEAN:	10.13	0.68	603.65	6312.92	0.423	18.51	185.01	0.0124	1.16	11.68	0.0008
	STD DEV:	5.82	0.39	50.94	4147.60	0.278	0.66	99.36	0.0067	0.05	6.54	0.0004
TOTAL FOR CYCLE	MEAN:		10.357			10.889			0.404			0.0102
	STD DEV:		0.443			0.602			0.153			0.0026
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.051			0.039			0.0010
					STD DEV:	0.013			0.016			0.0002

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	19.90	3.98	770.64	15335.64	3.067	37.17	739.71	0.1479	0.29	5.79	0.0012
	STD DEV:	0.0	0.0	271.83	5409.46	1.082	6.49	129.23	0.0258	0.53	10.03	0.0020
6	MEAN:	58.20	0.29	1049.05	59233.81	0.295	24.33	1394.62	0.0070	2.82	298.38	0.0010
	STD DEV:	13.51	0.07	202.23	858.65	0.004	3.34	210.56	0.0011	4.89	360.92	0.0018
7	MEAN:	50.40	4.18	850.14	41926.16	3.480	21.41	1065.68	0.0885	6.53	388.86	0.0323
	STD DEV:	8.14	0.68	182.05	3872.13	0.321	2.91	81.12	0.0067	11.26	673.52	0.0559
9	MEAN:	38.67	3.87	1075.13	41422.91	4.142	23.58	896.81	0.0897	1.86	80.91	0.0081
	STD DEV:	4.10	0.41	92.08	3462.22	0.346	8.58	272.25	0.0272	3.23	140.13	0.0140
10	MEAN:	18.77	1.26	741.37	14062.07	0.942	50.20	923.73	0.0623	0.72	14.35	0.0010
	STD DEV:	1.15	0.08	323.72	6414.32	0.430	21.34	373.19	0.0250	1.25	24.85	0.0017
TOTAL FOR CYCLE	MEAN:		13.578			11.928			0.395			0.0435
	STD DEV:		1.220			1.155			0.064			0.0754
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.878			0.029			0.0023
					STD DEV:	0.009			0.007			0.0050

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	16.80	3.36	959.33	16134.75	3.227	32.39	542.69	0.1095	1.22	20.43	0.0041
	STD DEV:	1.83	0.37	275.49	5015.27	1.003	3.85	71.72	0.0143	0.98	15.93	0.0032
6	MEAN:	73.47	0.37	957.94	70284.63	0.351	36.71	2736.75	0.0137	7.22	532.17	0.0027
	STD DEV:	5.89	0.03	208.43	15439.13	0.077	10.78	993.87	0.0050	4.56	343.03	0.0017
7	MEAN:	59.80	4.96	675.05	38385.66	3.186	23.29	1378.21	0.1144	24.97	1374.72	0.1556
	STD DEV:	7.13	0.59	537.89	29339.79	2.352	6.93	345.54	0.0287	31.13	2155.59	0.1789
9	MEAN:	35.97	3.60	1083.45	39163.88	3.916	21.04	758.25	0.0758	3.09	109.09	0.0109
	STD DEV:	2.44	0.24	129.11	7353.88	0.735	1.81	102.85	0.0103	1.37	44.62	0.0044
10	MEAN:	17.20	1.15	1044.87	17954.94	1.203	34.55	594.53	0.0398	1.12	19.28	0.0013
	STD DEV:	0.69	0.05	46.72	526.06	0.035	3.74	73.74	0.0049	0.04	2.14	0.0001
TOTAL FOR CYCLE	MEAN:		13.440			11.884			0.352			0.1745
	STD DEV:		0.230			2.262			0.029			0.1810
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.886			0.026			0.0129
					STD DEV:	0.182			0.002			0.0132

```
ENGINE SUMMARY          SAMPLE NUMBER =  3.

 TEST                  MEASURED    FUEL       CO         CO        CO        HC        HC        HC         NO        NO        NO
 MODE                  FUEL FLOW   USED      LB/1K      LB/1K    EMISSION   LB/1K     LB/1K    EMISSION    LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.     LB FUEL     HOURS     LBS.     LB FUEL    HOURS      LBS.     LB FUEL    HOURS      LBS.

  2          MEAN:       12.90     2.58      703.19    9175.38    1.835     14.94    194.21    0.0388      1.47     18.96    0.0038
          STD DEV:        1.20     0.24      135.91    2618.47    0.524      1.83     41.25    0.0083      0.31      4.38    0.0009

  6          MEAN:       71.87     0.36     1154.85   82988.38    0.415     15.19   1090.98    0.0055      2.49    178.88    0.0009
          STD DEV:        1.78     0.01        5.66    1654.12    0.008      0.66     20.63    0.0001      0.64     46.45    0.0002

  7          MEAN:       71.87     5.96     1154.85   82988.38    6.888     15.19   1090.98    0.0906      2.49    178.88    0.0148
          STD DEV:        1.78     0.15        5.66    1654.12    0.138      0.66     20.63    0.0017      0.64     46.45    0.0039

  9          MEAN:       19.17     1.92     1122.10   21508.28    2.151     22.08    422.42    0.0422      1.80     34.47    0.0034
          STD DEV:        2.71     0.27        2.35    3061.84    0.306      0.40     51.69    0.0052      0.38      8.34    0.0008

 10          MEAN:       11.70     0.78      589.63    6899.61    0.462     12.32    144.14    0.0097      1.78     20.83    0.0014
          STD DEV:        0.01     0.00       35.85     419.45    0.028      0.69      8.11    0.0005      0.39      4.59    0.0003

TOTAL FOR CYCLE       MEAN:  11.605                               11.751                       0.187                         0.0244
                   STD DEV:   0.630                                0.981                       0.012                         0.0058

TOTAL FOR CYCLE/LB FUEL                                 MEAN:     1.012                       0.016                         0.0021
                                                     STD DEV:     0.029                       0.000                         0.0005
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ENGINE SUMMARY          SAMPLE NUMBER =  3.

 TEST                  MEASURED    FUEL       CO         CO        CO        HC        HC        HC         NO        NO        NO
 MODE                  FUEL FLOW   USED      LB/1K      LB/1K    EMISSION   LB/1K     LB/1K    EMISSION    LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.     LB FUEL     HOURS     LBS.     LB FUEL    HOURS      LBS.     LB FUEL    HOURS      LBS.

  2          MEAN:        7.80     1.56      709.74    5676.49    1.135     21.87    171.55    0.0343      1.40     10.64    0.0021
          STD DEV:        1.28     0.26      168.93    2111.23    0.422      1.53     36.55    0.0073      0.37      1.79    0.0004

  6          MEAN:       57.10     0.29      862.15   50125.96    0.251     15.31    883.85    0.0044      8.67    470.23    0.0024
          STD DEV:        8.03     0.04      249.92   21754.54    0.109      3.93    303.19    0.0015     10.13    535.43    0.0027

  7          MEAN:       57.77     4.79      850.49   50252.54    4.171     14.97    876.13    0.0727      9.42    454.86    0.0378
          STD DEV:        9.18     0.76      284.49   22951.25    1.905      3.64    308.31    0.0256     10.37    549.74    0.0456

  9          MEAN:       14.97     1.50      813.70   12172.62    1.217     19.00    284.10    0.0284      3.22     48.22    0.0043
          STD DEV:        0.85     0.09       40.47     789.53    0.079      0.72     11.11    0.0011      0.68     10.39    0.0010

 10          MEAN:        5.83     0.39      398.41    2326.62    0.156     19.52    114.02    0.0076      2.01     11.62    0.0008
          STD DEV:        0.98     0.07        4.07     411.66    0.028      3.38     29.77    0.0020      0.54      3.52    0.0002

TOTAL FOR CYCLE       MEAN:   8.528                                6.930                       0.147                         0.0478
                   STD DEV:   1.025                                2.463                       0.036                         0.0492

TOTAL FOR CYCLE/LB FUEL                                 MEAN:     0.800                       0.017                         0.0059
                                                     STD DEV:     0.204                       0.003                         0.0064
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ENGINE SUMMARY          SAMPLE NUMBER =  3.

 TEST                  MEASURED    FUEL       CO         CO        CO        HC        HC        HC         NO        NO        NO
 MODE                  FUEL FLOW   USED      LB/1K      LB/1K    EMISSION   LB/1K     LB/1K    EMISSION    LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.     LB FUEL     HOURS     LBS.     LB FUEL    HOURS      LBS.     LB FUEL    HOURS      LBS.

  2          MEAN:       10.07     2.01     1067.57   10483.44    2.177     41.19    451.86    0.0904      0.37      3.42    0.0007
          STD DEV:        2.02     0.40      104.79    3304.20    0.661     27.66    393.75    0.0787      0.22      1.73    0.0003

  6          MEAN:       58.63     0.34     1092.03   74954.06    0.375     15.33   1051.03    0.0053      1.09     75.04    0.0004
          STD DEV:        1.15     0.01       23.00    2275.38    0.011      3.22    216.50    0.0011      0.01      0.85    0.0000

  7          MEAN:       58.63     5.70     1092.03   74954.06    6.221     15.33   1051.03    0.0872      1.09     75.04    0.0062
          STD DEV:        1.15     0.10       23.00    2275.38    0.189      3.22    216.50    0.0180      0.01      0.85    0.0001

  9          MEAN:       17.60     1.76      875.78   15413.73    1.541     17.54    308.68    0.0309      2.91     51.22    0.0051
          STD DEV:        0.0      0.0        14.75     259.48    0.026      1.35     32.74    0.0033      0.51      9.06    0.0009

 10          MEAN:        7.80     0.52      838.86    6951.46    0.465     22.39    175.05    0.0117      0.83      6.50    0.0004
          STD DEV:        0.52     0.33       75.64     969.14    0.065      2.18     25.58    0.0017      0.03      0.23    0.0000

TOTAL FOR CYCLE       MEAN:  10.336                               10.780                       0.225                         0.0128
                   STD DEV:   0.437                                0.716                       0.059                         0.0007

TOTAL FOR CYCLE/LB FUEL                                 MEAN:     1.042                       0.022                         0.0012
                                                     STD DEV:     0.023                       0.005                         0.0000
```

ENGINE SUMMARY SAMPLE NUMBER = 3. Ø-320

```
  TEST              MEASURED    FUEL       CO         CO         CO        HC         HC        HC         NO         NO        NO
  MODE              FUEL FLOW   USED      LB/1K      LB/1K    EMISSION    LB/1K      LB/1K   EMISSION     LB/1K      LB/1K   EMISSION
                      LB/HR     LBS.     LB FUEL     HOURS      LBS.     LB FUEL     HOURS      LBS.     LB FUEL     HOURS      LBS.

   2        MEAN:     19.17     3.83     1104.02   21139.71     4.228      29.70     566.74    0.1133      0.37       7.17    0.0014
         STD DEV:      0.64     0.13      109.26    1854.79     0.371      11.76     214.04    0.0428      0.18       3.57    0.0007

   6        MEAN:     74.23     0.37     1183.62   87867.31     0.439      12.99     964.55    0.0048      0.82      60.72    0.0003
         STD DEV:      1.33     0.01       17.62    2249.58     0.011       0.56      56.47    0.0003      0.36      25.83    0.0001

   7        MEAN:     74.23     6.16     1183.62   87867.31     7.293      12.99     964.55    0.0801      0.82      60.72    0.0050
         STD DEV:      1.33     0.11       17.62    2249.58     0.187       0.56      56.47    0.0047      0.36      25.83    0.0021

   9        MEAN:     26.07     2.61     1179.67   30750.31     3.075      26.03     677.86    0.0678      0.83      21.50    0.0022
         STD DEV:      2.34     0.23       10.42    2778.62     0.278       1.43      62.82    0.0063      0.05       0.86    0.0001

  10        MEAN:     18.40     1.23      961.71   17694.23     1.186      18.52     340.54    0.0228      0.68      12.52    0.0008
         STD DEV:      0.69     0.05       24.26     768.00     0.051       0.64      12.52    0.0008      0.04       0.64    0.0000

TOTAL FOR CYCLE       MEAN:   14.205                           16.221                           0.289                          0.0098
                   STD DEV:    0.463                            0.867                           0.051                          0.0023

TOTAL FOR CYCLE/LB FUEL                               MEAN:     1.142                           0.020                          0.0007
                                                   STD DEV:     0.037                           0.003                          0.0002
```

MODEL SUMMARY SAMPLE NUMBER = 21.

```
  TEST              MEASURED    FUEL       CO         CO         CO        HC         HC        HC         NO         NO        NO
  MODE              FUEL FLOW   USED      LB/1K      LB/1K    EMISSION    LB/1K      LB/1K   EMISSION     LB/1K      LB/1K   EMISSION
                      LB/HR     LBS.     LB FUEL     HOURS      LBS.     LB FUEL     HOURS      LBS.     LB FUEL     HOURS      LBS.

   2        MEAN:     13.49     2.70      846.12   11875.16     2.375      28.12     402.78    0.0806      0.89      10.71    0.0021
         STD DEV:      5.03     1.01      240.71    6332.78     1.267      13.44     266.22    0.0532      0.64       8.84    0.0018

   6        MEAN:     67.59     0.34     1073.33   72853.94     0.364      24.54    1675.91    0.0084      3.42     226.20    0.0011
         STD DEV:      8.60     0.04      177.69   15798.13     0.079      16.56    1202.99    0.0060      4.91     298.27    0.0015

   7        MEAN:     64.62     5.36     1002.85   65842.50     5.465      22.16    1433.74    0.1190      7.02     441.59    0.0367
         STD DEV:      9.46     0.79      282.49   23520.74     1.952      15.53    1089.13    0.0904     14.59     960.98    0.0798

   9        MEAN:     24.62     2.46     1027.23   25878.88     2.588      21.55     539.68    0.0540      2.15      53.05    0.0053
         STD DEV:      9.06     0.91      136.73   11238.68     1.124       3.94     245.50    0.0246      1.45      55.55    0.0056

  10        MEAN:     12.83     0.86      746.93   10314.39     0.691      25.14     354.72    0.0238      1.19      13.83    0.0009
         STD DEV:      5.38     0.36      244.96    6364.07     0.425      14.14     313.67    0.0210      0.67       9.56    0.0006

TOTAL FOR CYCLE       MEAN:   11.721                           11.483                           0.286                          0.0462
                   STD DEV:    2.045                            2.860                           0.114                          0.0848

TOTAL FOR CYCLE/LB FUEL                               MEAN:     0.973                           0.024                          0.0038
                                                   STD DEV:     0.144                           0.010                          0.0064
                                                   ANALYSIS OF VARIANCE

          WITHIN DEGREES OF FREEDOM =    6                      BETWEEN DEGREES OF FREEDOM =  14

 TEST                 MEASURED    FUEL       CO          CO        CO        HC         HC         HC         NO         NO         NO
 MODE                FUEL FLOW    USED     LB/1K       LB/1K    EMISSION    LB/1K      LB/1K    EMISSION     LB/1K      LB/1K    EMISSION
                       LB/HR      LBS.    LB FUEL      HOURS      LBS.     LB FUEL     HOURS      LBS.      LB FUEL     HOURS       LBS.

   2     MS AMONG:     80.54      3.22  114814.31106488832.00   4.2596    279.69  160939.00   0.006438     0.82      128.62    0.000005
         MS WITHIN:     1.60      0.06   33565.71 11653526.00   0.4661    138.12   32273.71   0.001291     0.23       56.59    0.000002
          F RATIO:     50.40     50.40       3.42        9.14   9.1379      2.02       4.99   4.986667     3.64        2.27    2.272647
        VAR. AMONG:    26.32      1.05   27082.85 31611760.00   1.2645     47.19   42888.41   0.001716     0.20       24.01    0.000001
        VAR. COMB.:    27.91      1.12   60648.56 43265280.00   1.7306    185.31   75162.06   0.003006     0.42       80.60    0.000003
          R INTRA:      0.94      0.94       0.45        0.73   0.7306      0.25       0.57   0.570611     0.47        0.30    0.297859
         SIG COMB.:     5.28      1.06     246.27     6577.64   1.3155     13.61     274.16   0.054831     0.65        8.98    0.001796

   6     MS AMONG:    150.23      0.00   48702.50588726272.00   0.0147    646.84 3404749.00   0.000085    31.04   117127.31    0.000003
         MS WITHIN:    41.19      0.00   24234.93104232656.00   0.0026    115.22  608214.88   0.000015    21.14    76891.75    0.000002
          F RATIO:      3.65      3.65       2.01        5.65   5.6474      5.60       5.60   5.598018     1.47        1.52    1.523269
        VAR. AMONG:    36.35      0.00    8155.86161497856.00   0.0040    176.54  932178.00   0.000023     3.30    13411.85    0.000000
        VAR. COMB.:    77.53      0.00   32390.78265730512.00   0.0066    291.76 1540392.00   0.000039    24.44    90303.56    0.000002
          R INTRA:      0.47      0.47       0.25        0.61   0.6077      0.61       0.61   0.605160     0.14        0.15    0.148518
         SIG COMB.:     8.81      0.04     179.97    16301.24   0.0815     17.08    1241.13   0.006206     4.94      300.51    0.001503

   7     MS AMONG:    229.30      1.58  131102.13*************   9.5757    559.85 2833877.00   0.019523   308.13  1276280.00    0.008792
         MS WITHIN:    29.69      0.20   57815.64194594512.00   1.3406    104.78  480066.75   0.003307   172.05   772290.19    0.005320
          F RATIO:      7.72      7.72       2.27        7.14   7.1429      5.34       5.90   5.903123     1.79        1.65    1.652596
        VAR. AMONG:    66.53      0.46   24428.81398478592.00   2.7450    151.69  784603.31   0.005405    45.36   167996.56    0.001157
        VAR. COMB.:    96.23      0.66   82244.44593072896.00   4.0856    256.47 1264670.00   0.008712   217.41   940286.75    0.006478
          R INTRA:      0.69      0.69       0.30        0.67   0.6719      0.59       0.62   0.620403     0.21        0.18    0.178666
         SIG COMB.:     9.81      0.81     286.78    24353.09   2.0213     16.01    1124.58   0.093340    14.74      969.68    0.080484

   9     MS AMONG:    261.32      2.61   53206.66392465664.00   3.9247     23.66  169475.94   0.001595     2.64     3008.48    0.000030
         MS WITHIN:     5.35      0.05    3904.57 12240347.00   0.1224     12.04   13470.60   0.000135     1.88     3119.44    0.000031
          F RATIO:     48.87     48.87      13.63       32.06  32.0668      1.96      12.58  12.581062     1.40        0.96    0.964444
        VAR. AMONG:    85.32      0.85   16434.03126741760.00   1.2674      3.87   52001.77   0.000520     0.25      -36.99   -0.000000
        VAR. COMB.:    90.67      0.91   20339.60138982096.00   1.3898     15.91   65472.37   0.000655     2.14     3082.45    0.000031
          R INTRA:      0.94      0.94       0.81        0.91   0.9119      0.24       0.79   0.794254     0.12       -0.01   -0.011994
         SIG COMB.:     9.52      0.95     142.61    11799.07   1.1789      3.99     255.88   0.025587     1.46       55.52    0.005552

  10     MS AMONG:     34.09      0.38  160905.06114838688.00   0.5155    503.88  275856.50   0.001238     0.82       71.94    0.000000
         MS WITHIN:     5.35      0.02   16761.96  8642472.00   0.0388     69.56   22335.02   0.000100     0.29       99.83    0.000000
          F RATIO:     15.73     15.73       9.60       13.29  13.2876      7.24      12.35  12.350812     2.83        0.72    0.720664
        VAR. AMONG:    26.25      0.12   48047.69 35398736.00   0.1589    144.78   84507.13   0.000379     0.18       -9.30   -0.000000
        VAR. COMB.:    31.59      0.14   64809.64 44041200.00   0.1977    214.33  106842.13   0.000480     0.46       90.53    0.000000
          R INTRA:      0.83      0.83       0.74        0.80   0.8038      0.68       0.79   0.790953     0.38       -0.10   -0.102672
         SIG COMB.:     5.62      0.38     254.58     6636.46   0.4446     14.64     326.87   0.021900     0.68        9.51    0.000637

 TOTAL FOR CYCLE     MS AMONG:  13.243                           22.2266                         0.031435                          0.010349
                    MS WITHIN:   0.519                            2.1582                         0.005100                          0.005843
                     F RATIO:   25.577                           10.2989                         6.163188                          1.771275
                   VAR. AMONG:   4.255                            6.6895                         0.008778                          0.001502
                   VAR. COMB.:   4.774                            8.8476                         0.013879                          0.007345
                     R INTRA:    0.891                            0.7561                         0.632496                          0.204513
                    SIG COMB.:   2.185                            2.9745                         0.117808                          0.085701

 TOTAL FOR CYCLE/LB FUEL                          MS AMONG:      0.0437                          0.000197                          0.000057
                                                 MS WITHIN:      0.0111                          0.000047                          0.000034
                                                  F RATIO:       3.9353                          4.147436                          1.669597
                                                VAR. AMONG:      0.0109                          0.000050                          0.000008
                                                VAR. COMB.:      0.0219                          0.000097                          0.000042
                                                  R INTRA:       0.4965                          0.513574                          0.182472
                                                 SIG COMB.:      0.1481                          0.009859                          0.006466
```

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	8.20	1.64	1035.79	8493.46	1.699	212.46	1742.14	0.3484	0.80	6.54	0.0013
	STD DEV:	0.01	0.00	90.80	744.59	0.149	120.53	988.33	0.1977	0.86	7.07	0.0014
6	MEAN:	93.77	0.47	1164.18	109204.94	0.546	17.97	1684.97	0.0084	2.49	233.28	0.0012
	STD DEV:	1.16	0.01	70.78	7806.82	0.039	1.03	89.88	0.0004	1.00	92.34	0.0005
7	MEAN:	75.40	6.26	1142.87	86632.88	7.191	16.92	1279.89	0.1062	2.73	199.36	0.0165
	STD DEV:	8.83	0.73	84.90	16551.7C	1.374	0.71	206.38	0.0171	1.17	69.70	0.0058
9	MEAN:	27.77	2.78	983.83	27313.77	2.731	20.05	557.12	0.0557	5.22	145.01	0.0145
	STD DEV:	1.33	0.13	19.30	1285.04	0.128	1.57	54.47	0.0054	0.47	15.76	0.0016
10	MEAN:	8.60	0.58	1034.28	8905.66	0.597	279.61	2376.64	0.1591	1.09	9.78	0.0007
	STD DEV:	0.69	0.05	25.53	931.51	0.062	72.41	470.91	0.0316	0.84	8.23	0.0006
TOTAL FOR CYCLE	MEAN:	11.720				12.763			0.678			0.0342
	STD DEV:	0.653				1.370			0.239			0.0091
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.087			0.057			0.0030
					STD DEV:	0.058			0.017			0.0009

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	15.23	3.05	951.45	14438.82	2.888	83.51	1267.08	0.2534	0.87	13.36	0.0027
	STD DEV:	0.98	0.20	103.27	996.06	0.199	42.99	669.18	0.1338	0.24	4.40	0.0009
6	MEAN:	55.10	0.28	960.81	52964.89	0.265	17.90	986.60	0.0049	4.94	271.36	0.0014
	STD DEV:	1.04	0.01	36.44	2996.06	0.015	0.86	63.68	0.0003	1.02	52.03	0.0003
7	MEAN:	43.90	3.64	861.55	37822.21	3.139	16.71	733.54	0.0609	9.95	436.61	0.0362
	STD DEV:	0.0	0.0	209.38	9192.01	0.763	3.68	161.56	0.0134	8.74	383.73	0.0318
9	MEAN:	28.10	2.81	843.69	23707.77	2.371	18.82	528.82	0.0529	7.46	209.57	0.0210
	STD DEV:	0.01	0.0	185.65	5216.73	0.522	2.79	78.37	0.0078	4.00	112.44	0.0112
10	MEAN:	14.10	0.94	1142.04	16102.73	1.079	110.65	1560.15	0.1045	0.36	5.04	0.0003
	STD DEV:	0.02	0.00	74.71	1053.39	0.071	62.92	887.15	0.0594	0.33	4.64	0.0003
TOTAL FOR CYCLE	MEAN:	10.721				9.741			0.477			0.0616
	STD DEV:	0.191				1.253			0.185			0.0411
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.910			0.045			0.0057
					STD DEV:	0.133			0.018			0.0038

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	18.37	3.67	533.56	9664.88	1.933	86.26	1548.74	0.3007	1.48	27.92	0.0056
	STD DEV:	1.79	0.36	120.81	1244.10	0.249	46.42	736.36	0.1473	0.59	13.53	0.0027
6	MEAN:	95.73	0.48	557.60	82294.96	0.411	24.96	2464.57	0.0143	13.47	1232.84	0.0065
	STD DEV:	3.35	0.02	137.02	15111.73	0.076	1.12	207.36	0.0010	4.15	591.64	0.0030
7	MEAN:	66.03	5.48	670.39	44407.48	3.686	14.87	981.62	0.0815	14.55	956.78	0.0794
	STD DEV:	3.74	0.31	57.95	6403.52	0.531	1.07	88.01	0.0073	1.95	88.66	0.0074
9	MEAN:	25.40	2.54	677.01	17215.75	1.722	24.91	637.19	0.0637	6.71	170.74	0.0171
	STD DEV:	1.83	0.18	71.84	2503.25	0.250	5.12	169.18	0.0169	1.38	38.73	0.0039
10	MEAN:	18.77	1.26	486.77	9152.43	0.613	137.43	2566.71	0.1718	1.32	24.60	0.0017
	STD DEV:	1.15	0.08	31.88	1057.33	0.071	48.29	841.42	0.0566	0.26	0.50	0.0000
TOTAL FOR CYCLE	MEAN:	13.430				8.365			0.641			0.1102
	STD DEV:	0.427				0.264			0.111			0.0050
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.623			0.048			0.0082
					STD DEV:	0.014			0.009			0.0004

MODEL SUMMARY SAMPLE NUMBER = 9.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	13.93	2.79	840.26	10865.71	2.173	127.41	1519.32	0.3039	1.15	15.96	0.0032
	STD DEV:	4.62	0.42	250.25	2655.75	0.573	93.29	731.10	0.1462	0.66	12.35	0.0025
6	MEAN:	81.53	0.41	994.20	81488.94	0.407	21.94	1946.71	0.0092	6.97	599.16	0.0030
	STD DEV:	19.93	0.10	156.62	25845.50	0.129	6.07	832.16	0.0042	6.01	601.05	0.0031
7	MEAN:	61.78	5.13	891.61	56287.53	4.672	16.16	994.35	0.0820	9.79	539.31	0.0441
	STD DEV:	14.81	1.23	236.57	25019.37	2.077	2.18	274.29	0.0228	6.36	390.59	0.0324
9	MEAN:	27.03	2.71	834.84	22745.76	2.275	21.26	574.38	0.0576	6.45	175.11	0.0175
	STD DEV:	1.70	0.17	165.42	5331.34	0.533	4.11	103.64	0.0119	2.33	56.26	0.0065
10	MEAN:	13.82	0.93	887.70	11387.07	0.763	175.82	2165.50	0.1452	0.92	13.17	0.0009
	STD DEV:	4.46	0.30	307.26	3646.08	0.244	95.23	801.73	0.0537	0.63	17.06	0.0007
TOTAL FOR CYCLE	MEAN:	11.357				10.290			0.599			0.0690
	STD DEV:	1.253				2.162			0.186			0.0395
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.873			0.050			0.0056
					STD DEV:	0.216			0.014			0.0030

```
                                         ANALYSIS OF VARIANCE

        WITHIN DEGREES OF FREEDOM =   2                     BETWEEN DEGREES OF FREEDOM =   6                                    IO-360

TEST                   MEASURED     FUEL        CO          CO          CO        HC          HC          HC         NO          NO          NO
MODE                  FUEL FLOW     USED      LB/1K       LB/1K    EMISSION     LB/1K       LB/1K    EMISSION     LB/1K       LB/1K    EMISSION
                        LB/HR       LBS.     LB FUEL      HOURS       LBS.     LB FUEL      HOURS       LBS.     LB FUEL      HOURS       LBS.

  2      MS AMONG:      81.32       3.25  216993.81 29755600.00  1.1902  16280.68   171210.50   0.006848     0.42      357.61   0.000014
        MS WITHIN:       1.39       0.06   11168.23  1031440.00  0.0413   6176.75   655609.81   0.026224     0.40       84.10   0.000003
         F RATIO:      58.55      58.55      19.43       28.85 28.8498      2.64        0.26   0.261142     1.05        4.25   4.252012
      VAR. AMONG:      26.64       1.07   68608.50  9574720.00  0.3830   3367.98 -161466.44  -0.006459     0.01       91.17   0.000004
      VAR. COMB.:      28.03       1.12   79776.69 10606160.00  0.4242   9544.73   494143.38   0.019766     0.41      175.27   0.000007
        R INTRA:        0.95       0.95       0.86        0.90  0.9028      0.35       -0.33  -0.326763     0.02        0.52   0.520154
       SIG COMB.:       5.29       1.06     282.45     3256.71  0.6513     97.70      702.95   0.140590     0.64       13.24   0.002648

  6      MS AMONG:    1575.01       0.04   73003.00*************  0.0593    144.12  2715234.00   0.000068    99.60  1083770.00   0.000027
        MS WITHIN:       4.55       0.00    8370.66 99429024.00  0.0025      1.02    18239.33   0.000000    13.28   120424.88   0.000003
         F RATIO:     346.35     346.68       8.72       23.87 23.8701    141.53      148.87 148.899307     7.50        9.06   8.999516
      VAR. AMONG:     523.49       0.01   21544.11758081280.00  0.0190     47.70   898998.00   0.000022    28.77   321115.00   0.000008
      VAR. COMB.:     528.04       0.01   29914.77857510144.00  0.0214     48.72   917237.31   0.000023    42.06   441539.88   0.000011
        R INTRA:        0.99       0.99       0.72        0.99  0.8840      0.98        0.98   0.980119     0.68        0.73   0.727261
       SIG COMB.:      22.98       0.11     172.96    29283.27  0.1464      6.98      957.73   0.004789     6.48      664.48   0.003322

  7      MS AMONG:     784.95       5.41  169463.50************* 14.4974      3.33   224507.50   0.001547   106.40   450274.50   0.003102
        MS WITHIN:      30.68       0.21   19135.66133152336.00  0.9173      5.06    25480.16   0.000176    27.20    53322.00   0.000367
         F RATIO:      25.59      25.58       9.34       15.80 15.8047      0.76        8.81   8.810695     3.91        8.44   8.444407
      VAR. AMONG:     251.42       1.73   50442.60657088256.00  4.5267     -0.41    66342.44   0.000457    26.40   132317.50   0.000912
      VAR. COMB.:     282.10       1.94   68578.25790240512.00  5.4440      4.65    91822.56   0.000633    53.60   185639.50   0.001279
        R INTRA:        0.89       0.89       0.74        0.83  0.8315     -0.09        0.72   0.722497     0.49        0.71   0.712765
       SIG COMB.:      16.80       1.39     261.87    28111.22  2.3332      2.16      303.02   0.025151     7.32      430.86   0.035761

  9      MS AMONG:       6.50       0.07   70785.00 78560768.00  0.7856     31.14     9478.34   0.000095     3.90     3169.46   0.000032
        MS WITHIN:       1.71       0.02   13332.83 11710634.00  0.1171     12.15    12576.55   0.000126     6.04     4797.52   0.000048
         F RATIO:       3.81       3.81       5.31        6.71  6.7089      2.56        0.75   0.753573     0.65        0.66   0.660456
      VAR. AMONG:       1.60       0.02   19150.72 22283376.00  0.2228      6.33    -1032.74  -0.000010    -0.71     -543.02  -0.000005
      VAR. COMB.:       3.31       0.03   32483.55 33994000.00  0.3399     18.48    11543.81   0.000115     5.33     4254.50   0.000043
        R INTRA:        0.48       0.48       0.59        0.66  0.6555      0.34       -0.09  -0.099494    -0.13       -0.13  -0.127626
       SIG COMB.:       1.82       0.18     160.23     5830.44  0.5830      4.30      107.44   0.010744     2.31       65.23   0.006523

 10      MS AMONG:      77.69       0.35  370396.75 50080240.00  0.2248  24739.46   854333.00   0.003835     0.76      315.35   0.000001
        MS WITHIN:       0.60       0.00    2416.74  1031768.00  0.0046   3844.50   572259.63   0.002569     0.27       29.84   0.000000
         F RATIO:     129.21     129.25     153.26       48.54 48.5323      6.44        1.49   1.492910     2.78       10.57  10.568154
      VAR. AMONG:      25.70       0.12  122656.63 16349488.00  0.0734   6964.98    94024.44   0.000422     0.16       95.17   0.000000
      VAR. COMB.:      26.30       0.12  125073.31 17381248.00  0.0780  10809.49   666284.06   0.002991     0.43      125.01   0.000001
        R INTRA:        0.98       0.98       0.98        0.94  0.9406      0.64        0.14   0.141118     0.37        0.76   0.761301
       SIG COMB.:       5.13       0.34     353.66     4169.08  0.2793    103.97      816.26   0.054689     0.66       11.18   0.000749

TOTAL FOR CYCLE     MS AMONG:   5.633                        15.1850                          0.034453                          0.004446
                   MS WITHIN:   0.215                         1.1720                          0.034433                          0.000600
                    F RATIO:   26.174                        12.9563                          1.000590                          7.407304
                 VAR. AMONG:    1.306                         4.6710                          0.000007                          0.001282
                 VAR. COMB.:    2.021                         5.8430                          0.034439                          0.001882
                   R INTRA:     0.494                         0.7994                          0.000197                          0.681099
                  SIG COMB.:    1.422                         2.4172                          0.185579                          0.043383

TOTAL FOR CYCLE/LB FUEL                          MS AMONG:    0.1646                          0.000131                          0.000021
                                                MS WITHIN:    0.0071                          0.000223                          0.000005
                                                 F RATIO:    23.1603                          0.587126                          4.103350
                                              VAR. AMONG:     0.0525                         -0.000031                          0.000005
                                              VAR. COMB.:     0.0596                          0.000192                          0.000010
                                                R INTRA:      0.8808                         -0.159588                          0.508466
                                               SIG COMB.:     0.2441                          0.013861                          0.003207
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ENGINE SUMMARY          SAMPLE NUMBER =  3.                                                                            IO-470

 TEST                  MEASURED    FUEL      CO         CO         CO        HC        HC        HC        NO        NO        NO
 MODE                  FUEL FLOW   USED     LB/1K      LB/1K    EMISSION    LB/1K     LB/1K    EMISSION   LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.    LB FUEL     HOURS      LBS.     LB FUEL    HOURS      LBS.    LB FUEL    HOURS      LBS.

   2        MEAN:        14.63     2.93    842.97    12504.01    2.501    202.55    3171.07   0.6342     0.37      4.34    0.0009
         STD DEV:        10.34     2.07     75.98     9440.61    1.888     71.26    2961.78   0.5924     0.26      2.39    0.0005

   6        MEAN:        92.57     0.46    920.88    85344.31    0.427     17.54    1611.04   0.0081     5.42    485.60    0.0024
         STD DEV:        22.38     0.11     60.51    21901.66    0.110      1.36     343.42   0.0017     1.12     45.30    0.0002

   7        MEAN:        75.57     6.27    858.33    64866.38    5.384     14.36    1085.21   0.0901     7.72    583.72    0.0484
         STD DEV:        12.67     1.05     17.68    11109.76    0.922      1.27     216.62   0.0180     0.23    100.90    0.0084

   9        MEAN:        42.77     4.28    937.68    40075.46    4.008     20.33     861.93   0.0862     4.87    208.53    0.0209
         STD DEV:         8.65     0.86      9.06     7915.59    0.792      1.34     113.81   0.0114     0.13     46.28    0.0046

  10        MEAN:        17.60     1.18    887.40    15811.97    1.059    314.17    5607.93   0.3757     0.33      6.01    0.0004
         STD DEV:        14.37     0.96     75.78    12747.88    0.854     38.32    4978.27   0.3335     0.03      5.21    0.0003

TOTAL FOR CYCLE       MEAN:   15.117                           13.378                        1.194                        0.0730
                   STD DEV:    4.643                            4.245                        0.947                        0.0126

TOTAL FOR CYCLE/LB FUEL                              MEAN:      0.883                        0.072                        0.0050
                                                  STD DEV:      0.008                        0.035                        0.0007
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ENGINE SUMMARY          SAMPLE NUMBER =  3.

 TEST                  MEASURED    FUEL      CO         CO         CO        HC        HC        HC        NO        NO        NO
 MODE                  FUEL FLOW   USED     LB/1K      LB/1K    EMISSION    LB/1K     LB/1K    EMISSION   LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.    LB FUEL     HOURS      LBS.     LB FUEL    HOURS      LBS.    LB FUEL    HOURS      LBS.

   2        MEAN:        29.30     5.86    815.85    23904.31    4.781    111.71    3273.13   0.6546     0.48     14.06    0.0028
         STD DEV:         0.02     0.01     43.04     1261.21    0.252     21.56     631.75   0.1264     0.41     12.00    0.0024

   6        MEAN:       113.47     0.57    906.26   102854.94    0.514     41.72    4724.40   0.0236     2.24    253.22    0.0013
         STD DEV:         2.37     0.01     40.26     5714.49    0.029     11.28    1241.98   0.0062     0.83     91.50    0.0005

   7        MEAN:        84.20     6.99    849.68    71495.25    5.934     27.89    2343.16   0.1945     2.05    170.77    0.0142
         STD DEV:         3.52     0.29     23.00     1574.19    0.131     11.58     960.46   0.0797     1.19     92.71    0.0077

   9        MEAN:        61.73     6.17   1021.73    63066.19    6.307     24.91    1539.43   0.1539     1.59     98.51    0.0099
         STD DEV:         2.71     0.27     43.35     3698.18    0.370      1.08     132.15   0.0132     0.87     56.12    0.0056

  10        MEAN:        29.30     1.96    850.31    24913.94    1.669    159.33    4668.39   0.3128     0.83     24.25    0.0016
         STD DEV:         0.0      0.00     41.35     1211.94    0.081     38.74    1135.05   0.0760     0.40     11.58    0.0008

TOTAL FOR CYCLE       MEAN:   21.552                           19.205                        1.339                        0.0297
                   STD DEV:    0.427                            0.337                        0.109                        0.0134

TOTAL FOR CYCLE/LB FUEL                              MEAN:      0.891                        0.062                        0.0014
                                                  STD DEV:      0.016                        0.006                        0.0006
```

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ENGINE SUMMARY          SAMPLE NUMBER =  3.

 TEST                  MEASURED    FUEL      CO         CO         CO        HC        HC        HC        NO        NO        NO
 MODE                  FUEL FLOW   USED     LB/1K      LB/1K    EMISSION    LB/1K     LB/1K    EMISSION   LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.    LB FUEL     HOURS      LBS.     LB FUEL    HOURS      LBS.    LB FUEL    HOURS      LBS.

   2        MEAN:        25.80     5.16    504.66    13030.21    2.606     30.53     782.84   0.1566     1.91     48.26    0.0097
         STD DEV:         1.04     0.21     72.30     2069.54    0.414     11.20     272.12   0.0544     1.58     37.48    0.0076

   6        MEAN:       109.00     0.54    675.67    73699.50    0.364     27.00    2980.79   0.0149    10.74   1093.21    0.0055
         STD DEV:        13.29     0.07     34.01    10027.90    0.050      4.52     866.71   0.0043     6.06    685.25    0.0034

   7        MEAN:        84.40     7.01    697.64    59018.72    4.898     14.29    1209.25   0.1004     8.17    676.54    0.0562
         STD DEV:         9.26     0.77     24.56     8514.38    0.707      0.58     180.98   0.0150     2.25    216.62    0.0180

   9        MEAN:        60.97     6.10    938.64    57252.41    5.725     16.93    1031.51   0.1032     4.15    253.28    0.0253
         STD DEV:         2.02     0.20     27.74     3330.77    0.333      1.13      60.18   0.0066     0.21     20.20    0.0020

  10        MEAN:        24.60     1.65    767.87    18882.60    1.266    122.43    3011.74   0.2018     0.83     20.46    0.0014
         STD DEV:         0.01     0.0     144.62     3557.69    0.238     89.40    2192.28   0.1474     0.34      8.47    0.0006

TOTAL FOR CYCLE       MEAN:   20.455                           14.864                        0.577                        0.0980
                   STD DEV:    1.122                            1.606                        0.222                        0.0149

TOTAL FOR CYCLE/LB FUEL                              MEAN:      0.725                        0.028                        0.0049
                                                  STD DEV:      0.042                        0.010                        0.0009
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                                                                                                              IO-470
ENGINE SUMMARY        SAMPLE NUMBER =  3.

 TEST              MEASURED    FUEL       CO         CO        CO        HC        HC        HC        NO        NO        NO
 MODE              FUEL FLOW   USED      LB/1K      LB/1K   EMISSION   LB/1K     LB/1K   EMISSION   LB/1K     LB/1K   EMISSION
                     LB/HR     LBS.     LB FUEL     HOURS     LBS.    LB FUEL    HOURS     LBS.    LB FUEL    HOURS     LBS.


  2       MEAN:     16.40      3.28     732.81   12095.20    2.419     62.77   1034.06   0.2068     1.03     16.83    0.0034
       STD DEV:      1.04      0.21     226.34    4091.06    0.818     29.03    480.84   0.0962     0.36      5.76    0.0012

  6       MEAN:    103.73      0.52     700.13   72558.88    0.363     37.26   3863.89   0.0193     9.75   1014.95    0.0051
       STD DEV:      6.38      0.03      17.85    2894.19    0.014      0.77    215.00   0.0011     0.73    139.26    0.0007

  7       MEAN:     76.80      6.37     764.13   58562.83    4.861     15.85   1214.47   0.1008     5.66    439.47    0.0365
       STD DEV:      4.43      0.37      41.53     514.00    0.042      0.85      6.24   0.0005     1.78    161.80    0.0134

  9       MEAN:     50.40      5.04     965.58   48675.35    4.868     15.94    802.45   0.0802     3.00    151.21    0.0151
       STD DEV:      1.04      0.10      17.96    1807.36    0.181      1.15     44.22   0.0044     0.21     10.42    0.0010

 10       MEAN:     15.23      1.02     781.58   11917.36    0.792    157.33   2387.75   0.1600     0.59      9.16    0.0006
       STD DEV:      0.98      0.07     245.93    3464.06    0.232     67.44   1044.92   0.0700     0.42      6.80    0.0005

TOTAL FOR CYCLE         MEAN:  16.234                       13.302                       0.567                        0.0607
                     STD DEV:   0.600                        1.239                       0.161                        0.0145

TOTAL FOR CYCLE/LB FUEL                              MEAN:   0.818                       0.035                        0.0037
                                                  STD DEV:   0.053                       0.009                        0.0008




MODEL SUMMARY         SAMPLE NUMBER = 12.

 TEST              MEASURED    FUEL       CO         CO        CO        HC        HC        HC        NO        NO        NO
 MODE              FUEL FLOW   USED      LB/1K      LB/1K   EMISSION   LB/1K     LB/1K   EMISSION   LB/1K     LB/1K   EMISSION
                     LB/HR     LBS.     LB FUEL     HOURS     LBS.    LB FUEL    HOURS     LBS.    LB FUEL    HOURS     LBS.


  2       MEAN:     21.53      4.31     724.07   15383.42    3.077    101.89   2065.28   0.4131     0.95     20.87    0.0042
       STD DEV:      7.84      1.57     175.94    6843.81    1.369     76.02   1786.88   0.3574     0.96     24.30    0.0049

  6       MEAN:    104.69      0.52     800.73   83614.44    0.418     30.88   3295.03   0.0165     6.86    712.99    0.0036
       STD DEV:     14.07      0.07     123.41   16579.38    0.083     11.09   1375.73   0.0069     4.31    477.38    0.0024

  7       MEAN:     80.24      6.66     792.44   63485.63    5.269     18.10   1463.02   0.1214     5.90    467.62    0.0388
       STD DEV:      8.29      0.69      72.97    8136.49    0.675      7.76    683.24   0.0567     3.02    237.77    0.0197

  9       MEAN:     53.97      5.40     965.91   52267.35    5.227     19.52   1058.83   0.1059     3.40    177.98    0.0178
       STD DEV:      9.13      0.91      42.73    9956.34    0.996      3.80    313.65   0.0314     1.35     69.10    0.0069

 10       MEAN:     21.68      1.45     821.79   17858.21    1.196    198.31   3018.95   0.2626     0.64     14.97    0.0010
       STD DEV:      8.47      0.57     137.06    7697.96    0.516     93.89   2759.22   0.1849     0.36     10.66    0.0007

TOTAL FOR CYCLE         MEAN:  18.340                       15.187                       0.919                        0.0653
                     STD DEV:   3.511                        3.215                       0.560                        0.0283

TOTAL FOR CYCLE/LB FUEL                              MEAN:   0.830                       0.049                        0.0037
                                                  STD DEV:   0.075                       0.025                        0.0016
```

ANALYSIS OF VARIANCE

WITHIN DEGREES OF FREEDOM = 3 BETWEEN DEGREES OF FREEDOM = 4

10-470

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MS AMONG:	152.49	6.10	70776.50	97247904.00	3.8899	16851.57	5389749.00	0.215590	1.49	1085.94	0.000043
	MS WITHIN:	27.27	1.09	16020.55	27933888.00	1.1173	1627.72	2369122.00	0.094765	0.72	404.44	0.000016
	F RATIO:	5.59	5.59	4.42	3.48	3.4814	10.35	2.27	2.274994	2.08	2.69	2.685072
	VAR. AMONG:	41.74	1.67	18251.98	23104672.00	0.9242	5074.61	1006875.63	0.040275	0.26	227.17	0.000009
	VAR. COMB.:	69.01	2.76	34272.53	51038560.00	2.0415	6702.34	3375997.00	0.135040	0.97	631.61	0.000025
	R INTRA:	0.60	0.60	0.53	0.45	0.4527	0.76	0.30	0.298245	0.26	0.36	0.359668
	SIG COMB.:	8.31	1.66	185.13	7144.13	1.4288	81.87	1837.39	0.367478	0.99	25.13	0.005026
6	MS AMONG:	243.48	0.01	51335.66	593696000.00	0.0148	351.20	5301268.00	0.000133	41.93	502668.31	0.000013
	MS WITHIN:	181.02	0.00	1689.38	155318272.00	0.0039	37.54	614402.38	0.000015	9.81	124847.50	0.000003
	F RATIO:	1.35	1.35	30.39	3.82	3.8223	9.36	8.63	8.628284	4.27	4.03	4.026246
	VAR. AMONG:	20.82	0.00	16548.76	146125904.00	0.0037	104.55	1562288.00	0.000039	10.71	125940.25	0.000003
	VAR. COMB.:	201.84	0.01	18238.14	301444096.00	0.0075	142.10	2176690.00	0.000054	20.52	250787.75	0.000006
	R INTRA:	0.10	0.10	0.91	0.48	0.4847	0.74	0.72	0.717734	0.52	0.50	0.502178
	SIG COMB.:	14.21	0.07	135.05	17362.14	0.0868	11.92	1475.36	0.007377	4.53	500.79	0.002504
7	MS AMONG:	66.70	0.46	17409.00	110254752.00	0.7595	129.56	1043554.31	0.007183	23.40	146040.19	0.001006
	MS WITHIN:	69.60	0.48	793.63	49682944.00	0.3423	34.20	250549.13	0.001726	3.79	22969.55	0.000158
	F RATIO:	0.96	0.96	21.94	2.22	2.2190	3.79	4.17	4.165133	6.18	6.36	6.357885
	VAR. AMONG:	-0.97	-0.01	5538.46	20190592.00	0.1391	31.79	264335.06	0.001821	6.54	41023.54	0.000283
	VAR. COMB.:	68.63	0.47	6332.08	69873536.00	0.4813	65.98	514884.19	0.003547	10.32	63993.09	0.000441
	R INTRA:	-0.01	-0.01	0.87	0.29	0.2889	0.48	0.51	0.513392	0.63	0.64	0.641058
	SIG COMB.:	8.28	0.69	79.57	8359.04	0.6938	8.12	717.55	0.059557	3.21	252.97	0.020996
9	MS AMONG:	247.50	2.47	4660.33	303009792.00	3.0300	49.24	336222.63	0.003362	6.15	13634.64	0.000136
	MS WITHIN:	21.83	0.22	763.25	22673408.00	0.2258	1.39	9187.88	0.000092	0.21	1451.88	0.000015
	F RATIO:	11.34	11.33	6.11	13.36	13.3616	35.35	36.59	36.593145	28.70	9.39	9.390676
	VAR. AMONG:	75.22	0.75	1299.03	93445456.00	0.9344	15.95	109011.56	0.001090	1.98	4060.92	0.000041
	VAR. COMB.:	97.06	0.97	2062.28	116118864.00	1.1612	17.34	118199.44	0.001182	2.19	5512.80	0.000055
	R INTRA:	0.78	0.78	0.63	0.80	0.8047	0.92	0.92	0.922276	0.90	0.74	0.736627
	SIG COMB.:	9.85	0.99	45.41	10775.85	1.0776	4.16	343.80	0.034380	1.48	74.25	0.007425
10	MS AMONG:	124.80	0.56	9645.66	91525792.00	0.4109	21979.98	6581893.00	0.029546	0.17	230.23	0.000001
	MS WITHIN:	51.89	0.23	22213.00	47158528.00	0.2117	3877.57	8000050.00	0.035912	0.11	69.84	0.000000
	F RATIO:	2.41	2.41	0.43	1.94	1.9408	5.67	0.82	0.822723	1.52	3.30	3.296395
	VAR. AMONG:	24.30	0.11	-4189.11	14789088.00	0.0664	6034.13	-472719.00	-0.002122	0.02	53.46	0.000000
	VAR. COMB.:	76.19	0.34	18023.89	61947616.00	0.2781	9911.70	7527331.00	0.033790	0.13	123.30	0.000001
	R INTRA:	0.32	0.32	-0.23	0.24	0.2387	0.61	-0.06	-0.062304	0.15	0.43	0.433577
	SIG COMB.:	8.73	0.58	134.25	7870.68	0.5273	99.56	2743.60	0.183821	0.36	11.10	0.000744
TOTAL FOR CYCLE	MS AMONG:		29.613			23.0743			0.493464			0.002415
	MS WITHIN:		5.840			5.5626			0.245828			0.000193
	F RATIO:		5.070			4.1481			2.007355			12.514117
	VAR. AMONG:		7.924			5.8372			0.082545			0.000741
	VAR. COMB.:		13.765			11.3998			0.328373			0.000934
	R INTRA:		0.576			0.5120			0.251477			0.793305
	SIG COMB.:		3.710			3.3764			0.573039			0.030557
TOTAL FOR CYCLE/LB FUEL	MS AMONG:					0.0177			0.001345			0.000008
	MS WITHIN:					0.0012			0.000355			0.000001
	F RATIO:					14.5543			3.785263			15.150770
	VAR. AMONG:					0.0055			0.000330			0.000003
	VAR. COMB.:					0.0067			0.000685			0.000003
	R INTRA:					0.8188			0.481441			0.825081
	SIG COMB.:					0.0818			0.026175			0.001756

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	34.00	6.80	611.83	20751.02	4.150	49.68	1679.14	0.3358	0.87	29.45	0.0059
	STD DEV:	1.04	0.21	97.31	2857.24	0.571	15.23	476.30	0.0953	0.13	4.27	0.0009
6	MEAN:	114.30	0.57	361.29	42171.25	0.211	9.95	1142.42	0.0057	33.26	3730.56	0.0187
	STD DEV:	10.98	0.05	119.85	18276.23	0.091	0.71	189.38	0.0009	10.24	995.40	0.0045
7	MEAN:	94.93	7.88	611.38	58599.35	4.864	9.90	945.27	0.0785	10.46	969.61	0.0805
	STD DEV:	9.30	0.77	109.62	14888.43	1.236	0.92	171.98	0.0143	5.65	465.88	0.0387
9	MEAN:	58.60	5.86	885.85	51896.56	5.190	13.88	813.08	0.0813	3.14	184.42	0.0184
	STD DEV:	1.04	0.10	20.80	367.65	0.037	0.39	24.94	0.0025	0.42	28.36	0.0028
10	MEAN:	38.67	2.59	841.46	32545.63	2.181	41.16	1593.22	0.1067	1.10	42.56	0.0029
	STD DEV:	1.75	0.12	20.10	1934.02	0.130	10.13	413.76	0.0277	0.25	9.63	0.0006
TOTAL FOR CYCLE	MEAN:		23.702			16.595			0.608			0.1263
	STD DEV:		0.599			1.529			0.087			0.0438
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.699			0.026			0.0053
					STD DEV:	0.049			0.003			0.0019

ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	21.70	4.34	593.74	13321.50	2.664	120.76	2713.55	0.5427	0.37	8.29	0.0017
	STD DEV:	2.08	0.42	342.82	4291.34	1.658	68.58	1658.55	0.3317	0.28	6.66	0.0013
6	MEAN:	128.90	0.64	566.93	73101.50	0.366	12.89	1661.96	0.0083	18.03	2330.06	0.0117
	STD DEV:	1.05	0.01	40.75	5774.20	0.029	1.16	147.95	0.0007	3.79	475.60	0.0024
7	MEAN:	114.87	9.53	938.30	107813.44	8.949	12.87	1478.22	0.1227	3.68	422.11	0.0350
	STD DEV:	0.99	0.08	52.23	6949.35	0.577	1.06	125.92	0.0105	0.77	35.21	0.0071
9	MEAN:	58.03	5.80	1201.95	69743.38	6.974	18.17	1054.48	0.1054	0.92	53.68	0.0054
	STD DEV:	1.75	0.18	9.54	1636.70	0.164	0.74	45.83	0.0046	0.07	5.91	0.0006
10	MEAN:	19.90	1.33	980.22	19500.45	1.307	106.65	2126.88	0.1425	0.64	12.74	0.0009
	STD DEV:	1.04	0.07	10.86	855.31	0.057	7.06	249.39	0.0167	0.05	0.85	0.0001
TOTAL FOR CYCLE	MEAN:		21.655			20.259			0.922			0.0546
	STD DEV:		0.532			2.268			0.332			0.0084
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.934			0.042			0.0025
					STD DEV:	0.082			0.014			0.0004

MODEL SUMMARY SAMPLE NUMBER = 6.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	27.85	5.57	602.74	17036.26	3.407	95.22	2196.34	0.4373	0.62	14.87	0.0038
	STD DEV:	6.90	1.38	225.60	6879.21	1.376	59.07	1229.66	0.2459	0.34	12.62	0.0025
6	MEAN:	121.60	0.61	464.11	57636.34	0.283	11.42	1402.19	0.0070	25.64	4033.31	0.0152
	STD DEV:	10.61	0.05	138.19	20831.44	0.104	1.43	322.62	0.0016	10.43	999.80	0.0050
7	MEAN:	106.90	8.71	774.86	83206.34	6.906	11.38	1211.76	0.1006	7.07	695.86	0.0578
	STD DEV:	12.42	1.31	194.86	28889.20	2.398	1.85	321.53	0.0267	5.14	623.85	0.0352
9	MEAN:	58.37	5.83	1043.90	60813.99	6.082	16.02	933.78	0.0934	2.03	119.05	0.0119
	STD DEV:	1.33	0.13	173.74	9832.53	0.983	2.41	136.29	0.0136	1.25	73.92	0.0076
10	MEAN:	29.24	1.36	910.34	26023.03	1.744	73.91	1862.05	0.1245	0.87	27.65	0.0019
	STD DEV:	10.36	0.59	77.37	7269.27	0.487	36.71	422.84	0.0253	0.30	17.44	0.0017
TOTAL FOR CYCLE	MEAN:		22.578			19.427			0.765			0.0304
	STD DEV:		1.240			2.653			0.277			0.0486
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.817			0.036			0.0039
					STD DEV:	0.142			0.013			0.0023

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                                                     ANALYSIS OF VARIANCE

         WITHIN DEGREES OF FREEDOM =   1                         BETWEEN DEGREES OF FREEDOM =   4                          TSIO-520

 TEST                  MEASURED    FUEL      CO        CO        CO        HC        HC        HC         NO        NO        NO
 MODE                  FUEL FLOW   USED     LB/1K     LB/1K    EMISSION   LB/1K     LB/1K    EMISSION    LB/1K     LB/1K    EMISSION
                         LB/HR     LBS.    LB FUEL    HOURS      LBS.    LB FUEL    HOURS      LBS.     LB FUEL    HOURS      LBS.

   2     MS AMONG:  226.93       9.08     491.00 82797824.00  3.3119   7578.95 1604972.00  0.064200    0.37      671.49   0.000027
        MS WITHIN:    2.70       0.11   63497.00 38455040.00  1.5382   2467.51 1488825.00  0.059553    0.05       31.28   0.000001
         F RATIO:    84.05      84.04       0.01        2.15  2.1531      3.07       1.08  1.078032    7.76       21.46  21.464127
      VAR. AMONG:    74.74       2.99  -21002.00 14780928.00  0.5912   1703.81   38715.66  0.001549    0.11      213.40   0.000009
      VAR. COMB.:    77.44       3.10   42495.00 53235968.00  2.1294   4171.32 1527540.00  0.061102    0.16      244.68   0.000010
        R INTRA:      0.97       0.97      -0.49        0.28  0.2777      0.41       0.03  0.025351    0.69        0.87   0.872145
       SIG COMB.:     8.80       1.76     206.14     7296.30  1.4593     64.59    1235.94  0.247188    0.40       15.64   0.003128

   6     MS AMONG:  319.70       0.01   63433.31************  0.0359     12.99  404899.00  0.000010  345.21  2942082.00   0.000074
        MS WITHIN:   60.81       0.00    8012.67183681024.00  0.0046      0.93   28877.75  0.000001   59.61   513967.50   0.000013
         F RATIO:     5.26       5.26       7.92        7.81  7.8125     14.03      14.02 14.020529    5.79        5.72   5.724342
      VAR. AMONG:    86.29       0.00   18473.55417113344.00  0.0104      4.02  125340.38  0.000003   95.20   809371.31   0.000020
      VAR. COMB.:   147.11       0.00   26486.22600794368.00  0.0150      4.95  154218.13  0.000004  154.81 1323338.0C   0.000033
        R INTRA:      0.59       0.59       0.70        0.69  0.6943      0.81       0.81  0.812740    0.61        0.61   0.611617
       SIG COMB.:    12.13       0.06     162.75    24511.11  0.1226      2.22     392.71  0.001964   12.44     1150.36   0.005752

   7     MS AMONG:  595.98       4.11  160319.00************ 25.0281     13.20  426057.00  0.002935   69.04   449633.19   0.003097
        MS WITHIN:   43.72       0.30    7372.25134972416.00  0.9299      0.98   22716.50  0.000156   16.24   112151.19   0.000773
         F RATIO:    13.63      13.63      21.75       26.92 26.9158     13.42      18.76 18.756561    4.25        4.01   4.009133
      VAR. AMONG:   184.09       1.27   50982.25************  8.0327      4.07  134446.81  0.000926   17.60   112494.00   0.000775
      VAR. COMB.:   227.81       1.57   58354.50************  8.9626      5.06  157163.31  0.001083   33.84   224645.19   0.001548
        R INTRA:      0.81       0.81       0.87        0.90  0.8963      0.81       0.86  0.855467    0.52        0.50   0.500760
       SIG COMB.:    15.09       1.25     241.57    36069.31  2.9938      2.25     396.44  0.032904    5.82      473.97   0.039339

   9     MS AMONG:    0.50       0.00  149887.00477765632.00  4.7776     27.71   87411.00  0.000874    7.38    25641.03   0.000256
        MS WITHIN:    2.07       0.02     261.75  1406976.00  0.0141      0.35    1361.25  0.000014    0.09      419.68   0.000004
         F RATIO:     0.24       0.22     572.63      339.57338.0327     79.34      64.21 64.193695   79.51       61.10  61.10[illegible]91
      VAR. AMONG:    -0.52      -0.01   49875.08158786208.00  1.5878      9.12   28683.25  0.000287    2.43     8407.12   0.000084
      VAR. COMB.:     1.55       0.02   50136.83160193184.00  1.6019      9.47   30044.50  0.000300    2.52     8426.80   0.000088
        R INTRA:     -0.34      -0.35       0.99        0.99  0.9912      0.96       0.95  0.954678    0.96        0.95   0.952457
       SIG COMB.:     1.24       0.12     223.91    12656.75  1.2657      3.08     173.33  0.017333    1.59       93.95   0.009395

  10     MS AMONG:  528.28       2.37   28886.00255265536.00  1.1459   6434.27  427163.00  0.001918    0.32     1333.69   0.000006
        MS WITHIN:    2.07       0.01     261.00  2236416.00  0.0100     76.20  116697.25  0.000524    0.07       46.77   0.000000
         F RATIO:   254.94     254.95     110.67      114.14114.2132     84.44       3.66  3.660565    4.46       28.51  28.514496
      VAR. AMONG:   175.40       0.79    9541.66 84343040.00  0.3786   2119.36  103488.56  0.000465    0.10      428.97   0.000002
      VAR. COMB.:   177.47       0.80    9802.66 86579456.00  0.3887   2195.55  220185.81  0.000988    0.13      475.74   0.000002
        R INTRA:      0.99       0.99       0.97        0.97  0.9742      0.97       0.47  0.470018    0.74        0.90   0.901686
       SIG COMB.:    13.32       0.39      99.01     9304.81  0.6234     46.86     469.24  0.031439    0.36       21.81   0.001461

TOTAL FOR CYCLE    MS AMONG:   6.280                         20.1389                        0.147526                        0.007722
                  MS WITHIN:   0.321                          3.7408                        0.058930                        0.000995
                    F RATIO:  19.577                          5.3836                        2.503410                        7.757502
                 VAR. AMONG:   1.986                          5.4660                        0.029532                        0.002242
                 VAR. COMB.:   2.307                          9.2069                        0.048462                        0.003238
                   R INTRA:    0.861                          0.5937                        0.333438                        0.692544
                  SIG COMB.:   1.519                          3.0343                        0.297425                        0.056499

TOTAL FOR CYCLE/LB FUEL                           MS AMONG:   0.0827                        0.000419                        0.000012
                                                 MS WITHIN:   0.0046                        0.000109                        0.000002
                                                   F RATIO:  17.9090                        3.832132                        6.352232
                                                VAR. AMONG:   0.0260                        0.000103                        0.000003
                                                VAR. COMB.:   0.0306                        0.000213                        0.000005
                                                  R INTRA:    0.8493                        0.485608                        0.640815
                                                 SIG COMB.:   0.1750                        0.014588                        0.002281
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IO-540

ENGINE SUMMARY SAMPLE NUMBER = 2.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	19.35	3.87	901.58	17206.68	3.441	134.16	2715.62	0.5431	0.82	16.55	0.0033
	STD DEV:	2.47	0.49	193.12	1505.53	0.301	96.64	2201.97	0.4404	0.48	11.42	0.0023
6	MEAN:	128.90	0.64	1223.09	158061.56	0.790	18.53	2405.70	0.0120	0.94	116.53	0.0006
	STD DEV:	16.55	0.08	48.95	26546.96	0.133	2.09	576.23	0.0029	0.56	56.17	0.0003
7	MEAN:	108.40	9.00	1233.68	133898.13	11.114	17.93	1939.30	0.1610	0.68	72.69	0.0060
	STD DEV:	4.10	0.34	81.81	13929.38	1.156	2.10	153.61	0.0128	0.57	59.47	0.0049
9	MEAN:	55.10	5.51	1195.06	66301.56	6.630	20.57	1107.98	0.1108	0.86	43.06	0.0043
	STD DEV:	11.60	1.16	78.27	18171.27	1.817	4.43	5.39	0.0005	0.73	30.52	0.0031
10	MEAN:	16.40	1.10	1120.59	18404.36	1.233	202.09	3293.44	0.2207	0.16	2.64	0.0002
	STD DEV:	1.70	0.11	31.48	2417.91	0.162	24.50	58.92	0.0039	0.03	0.80	0.0001
TOTAL FOR CYCLE	MEAN:		20.120			23.208			1.048			0.0144
	STD DEV:		1.764			2.643			0.434			0.0060
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.153			0.051			0.0007
					STD DEV:	0.019			0.017			0.0004

ENGINE SUMMARY SAMPLE NUMBER = 2.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	24.65	4.93	831.87	20548.88	4.110	35.01	881.32	0.1763	1.09	26.80	0.0054
	STD DEV:	2.47	0.49	35.03	2922.05	0.584	14.92	451.97	0.0904	0.08	0.68	0.0001
6	MEAN:	137.10	0.69	1177.41	161094.06	0.805	14.85	2028.97	0.0101	0.88	121.28	0.0006
	STD DEV:	17.40	0.09	37.71	15309.52	0.077	0.81	146.76	0.0007	0.13	33.65	0.0002
7	MEAN:	109.00	9.05	1156.28	126034.06	10.461	15.59	1699.50	0.1411	1.09	118.33	0.0098
	STD DEV:	0.0	0.02	41.93	4571.41	0.380	1.22	133.37	0.0111	0.18	19.94	0.0017
9	MEAN:	57.10	5.71	1151.43	65855.44	6.586	18.86	1076.26	0.1076	1.05	59.73	0.0060
	STD DEV:	6.22	0.62	34.87	9157.37	0.916	0.26	102.48	0.0102	0.06	2.90	0.0003
10	MEAN:	23.75	1.59	1044.66	24801.64	1.662	97.70	2352.80	0.1576	0.72	17.10	0.0011
	STD DEV:	1.20	0.08	14.93	901.27	0.060	54.03	1400.76	0.0939	0.00	0.95	0.0001
TOTAL FOR CYCLE	MEAN:		21.364			23.623			0.593			0.0229
	STD DEV:		1.111			1.863			0.183			0.0013
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.075			0.027			0.0010
					STD DEV:	0.030			0.007			0.0001

ENGINE SUMMARY SAMPLE NUMBER = 2.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	12.30	2.46	996.54	12181.60	2.436	224.70	2678.43	0.5357	0.46	5.87	0.0012
	STD DEV:	4.95	0.99	19.08	5117.68	1.024	34.50	687.92	0.1376	0.09	3.38	0.0007
6	MEAN:	90.55	0.45	1399.68	126940.94	0.635	25.53	2300.51	0.0115	0.25	23.18	0.0001
	STD DEV:	26.09	0.13	15.40	37909.40	0.190	0.86	588.56	0.0029	0.01	7.46	0.0000
7	MEAN:	50.95	4.23	1393.87	71026.75	5.895	27.01	1376.23	0.1142	0.19	9.65	0.0008
	STD DEV:	2.47	0.21	7.35	3825.57	0.318	0.21	77.30	0.0064	0.02	0.38	0.0000
9	MEAN:	26.40	2.64	1378.19	36386.23	3.638	33.29	878.73	0.0879	0.18	4.79	0.0005
	STD DEV:	0.0	0.0	9.31	225.27	0.022	1.08	29.57	0.0029	0.01	0.35	0.0000
10	MEAN:	11.40	0.76	1205.70	13854.63	0.922	155.76	1675.30	0.1122	0.19	2.14	0.0001
	STD DEV:	1.27	0.09	173.58	3570.44	0.239	157.71	1599.59	0.1072	0.05	0.81	0.0001
TOTAL FOR CYCLE	MEAN:		10.545			13.533			0.862			0.0027
	STD DEV:		1.100			1.113			0.024			0.0008
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.284			0.082			0.0003
					STD DEV:	0.015			0.005			0.0001

MODEL SUMMARY SAMPLE NUMBER = 6.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	18.77	3.75	906.66	16645.71	3.329	131.29	2091.79	0.4184	0.79	15.40	0.0033
	STD DEV:	6.17	1.23	112.15	4645.58	0.929	96.70	1408.78	0.2818	0.36	10.77	0.0022
6	MEAN:	118.85	0.59	1266.73	148693.81	0.743	19.64	2245.06	0.0112	0.69	87.00	0.0004
	STD DEV:	27.30	0.14	133.79	27588.69	0.138	4.97	412.58	0.0021	0.32	57.59	0.0003
7	MEAN:	89.45	7.42	1261.27	110319.63	9.157	20.19	1671.68	0.1387	0.65	66.96	0.0056
	STD DEV:	29.92	2.48	115.47	31378.75	2.604	5.50	270.63	0.0225	0.43	56.21	0.0047
9	MEAN:	46.20	4.62	1241.56	56180.45	5.613	24.24	1020.99	0.1021	0.70	35.86	0.0036
	STD DEV:	16.45	1.65	114.30	17832.39	1.783	7.34	120.89	0.0121	0.52	28.68	0.0029
10	MEAN:	17.18	1.15	1123.65	19021.54	1.274	151.85	2440.51	0.1635	0.35	7.29	0.0005
	STD DEV:	5.66	0.38	109.70	5297.16	0.355	38.69	1197.14	0.0802	0.28	7.63	0.0005
TOTAL FOR CYCLE	MEAN:		17.543			20.122			0.834			0.0133
	STD DEV:		5.593			5.331			0.294			0.0095
TOTAL FOR CYCLE/LB FUEL					MEAN:	1.173			0.053			0.0007
					STD DEV:	0.096			0.026			0.0004

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                                              ANALYSIS OF VARIANCE

       WITHIN DEGREES OF FREEDOM =   2                    BETWEEN DEGREES OF FREEDOM =   3                           IO-540

TEST             MEASURED    FUEL       CO          CO         CO        HC         HC          HC        NO        NO        NO
MODE             FUEL FLOW   USED     LB/1K       LB/1K     EMISSION    LB/1K      LB/1K     EMISSION    LB/1K     LB/1K    EMISSION
                   LB/HR     LBS.    LB FUEL      HOURS       LBS.     LB FUEL     HOURS       LBS.     LB FUEL    HOURS      LBS.


  2     MS AMONG:    76.77    3.07   12002.00 35479040.00  1.4191   18003.42 2198539.00   0.087942    0.20     219.02   0.000009
       MS WITHIN:    12.25    0.49   12961.66 12331861.00  0.4933    3582.83 1842067.00   0.073683    0.08      47.42   0.000002
        F RATIO:      6.27    6.27       C.93        2.88  2.8770       5.02       1.19   1.193507    2.42       4.62   4.618977
      VAR. AMONG:    32.26    1.29    -479.83 11573584.00  0.4629    7210.29  178236.00   0.007129    0.06      85.80   0.000003
      VAR. COMB.:    44.51    1.78   12481.83 23905440.00  0.9562   10793.12 2020303.00   0.080813    0.14     133.22   0.000005
        R INTRA:      0.72    0.72      -0.04        0.48  0.4841       0.67       0.09   0.088219    0.42       0.64   0.644063
       SIG COMB.:     6.67    1.33     111.72     4889.32  0.9779     103.89    1421.37   0.284275    0.38      11.54   0.002308

  6     MS AMONG:  1234.94    0.03   27563.0071471 5136.00  0.0179      58.85   75565.50   0.000002    0.29    6120.61   0.000000
       MS WITHIN:   419.08    0.01    1350.67792081664.00  0.0198       1.92  233324.31   0.000006    0.11    1447.69   0.000000
        F RATIO:      2.95    2.95      20.41        0.90  0.9023      30.60       0.32   0.324015    2.62       4.23   4.227806
      VAR. AMONG:   407.93    0.01   13106.16-38683264.00 -0.0010      28.47  -78879.38  -0.000002    0.09    2336.46   0.000000
      VAR. COMB.:   827.01    0.02   14456.83753398272.00  0.0188      30.39  154444.94   0.000004    0.20    3784.15   0.000000
        R INTRA:      0.49    0.49       0.91       -0.05 -0.0514       0.94      -0.51  -0.510557    0.45       0.62   0.617430
       SIG COMB.:    28.76    0.14     120.24    27448.10  0.1372       5.51     392.99   0.001965    0.44      61.52   0.000308

  7     MS AMONG:  2223.56   15.32   29372.50************* 16.1671      72.72  159669.00   0.001100    0.40    5933.16   0.000041
       MS WITHIN:     7.65    0.05    2835.00 76520096.00  0.5273       1.98   15786.00   0.000109    0.12    1311.31   0.000009
        F RATIO:    290.82  289.97      10.36       30.67 30.6630      36.79      10.12  10.113787    3.20       4.52   4.524550
      VAR. AMONG:  1107.96    7.63   13268.75*************  7.8199      35.37   71951.50   0.000496    0.14    2310.92   0.000016
      VAR. COMB.:  1115.60    7.69   16103.75*************  8.3472      37.35   87737.50   0.000604    0.26    3622.23   0.000025
        R INTRA:      0.99    0.99       0.82        0.94  0.9368       0.95       0.82   0.820043    0.53       0.64   0.637980
       SIG COMB.:    33.40    2.77     126.90    34808.79  2.8892       6.11     296.21   0.024584    0.51      60.18   0.004995

  9     MS AMONG:   590.07    5.90   28956.00587932672.00  5.8795     124.16   30864.00   0.000309    0.42    1585.96   0.000016
       MS WITHIN:    57.73    0.58    2470.33138034512.00  1.3803       6.95    3782.33   0.000038    0.18     313.35   0.000003
        F RATIO:     10.22   10.22      11.72        4.26  4.2595      17.86       8.16   8.159410    2.30       5.06   5.064548
      VAR. AMONG:   266.17    2.66   13242.83224948992.00  2.2496      58.60   13540.83   0.000135    0.12     636.81   0.000006
      VAR. COMB.:   323.90    3.24   15713.16362983424.00  3.6299      65.56   17323.16   0.000173    0.30     950.15   0.000010
        R INTRA:      0.82    0.92       0.84        0.62  0.6197       0.89       0.78   0.781645    0.39       0.67   0.670214
       SIG COMB.:    18.00    1.80     125.35    19052.13  1.9052       8.10     131.62   0.013161    0.55      30.82   0.003082

 10     MS AMONG:    77.18    0.35   12986.00 60446464.00  0.2713    5471.49 1320720.00   0.005929    0.20     144.33   0.000001
       MS WITHIN:     1.98    0.01   11035.33  6468864.00  0.0290    9463.67 1508096.00   0.006770    0.00       0.74   0.000000
        F RATIO:     38.95   38.95       1.18        9.34  9.3440       0.58       0.88   0.875755  164.90     195.47 195.452194
      VAR. AMONG:    37.60    0.17     975.33 26988800.00  0.1212   -1996.09  -93688.00  -0.000421    0.10      71.80   0.000000
      VAR. COMB.:    39.58    0.18   12010.66 33457664.00  0.1502    7467.58 1414408.00   0.006349    0.10      72.54   0.000000
        R INTRA:      0.95    0.95       0.08        0.81  0.8067      -0.27      -0.07  -0.066237    0.99       0.99   0.989819
       SIG COMB.:     6.29    0.42     109.59     5784.26  0.3875      86.42    1189.29   0.079682    0.32       8.52   0.000571

TOTAL FOR CYCLE     MS AMONG:  75.152                   65.1978                          0.104581                      0.000205
                   MS WITHIN:   2.031                    3.8982                          0.074082                      0.000013
                     F RATIO:  37.011                   16.7251                          1.411703                     15.809781
                  VAR. AMONG:  36.561                   30.6498                          0.015250                      0.000096
                  VAR. COMB.:  38.591                   34.5480                          0.089331                      0.000109
                     R INTRA:   0.947                    0.8872                          0.170711                      0.881022
                   SIG COMB.:   6.212                    5.8779                          0.298883                      0.010445

TOTAL FOR CYCLE/LB FUEL                     MS AMONG:    0.0224                          0.001527                      0.000000
                                           MS WITHIN:    0.0005                          0.000118                      0.000000
                                             F RATIO:   43.3913                         12.980855                      6.155236
                                          VAR. AMONG:    0.0109                          0.000705                      0.000000
                                          VAR. COMB.:    0.0115                          0.000822                      0.000000
                                             R INTRA:    0.9543                          0.856947                      0.720484
                                           SIG COMB.:    0.1070                          0.028677                      0.000429
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ENGINE SUMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	25.80	5.16	860.94	22247.91	4.450	51.20	1323.92	0.2648	0.59	15.06	0.0030
	STD DEV:	1.04	0.21	58.18	2305.61	0.461	4.19	158.86	0.0318	0.19	4.24	0.0008
6	MEAN:	111.37	0.56	960.04	106904.63	0.535	21.50	2392.43	0.0120	6.25	696.69	0.0035
	STD DEV:	2.70	0.01	6.75	1878.48	0.009	4.28	463.56	0.0023	0.90	114.55	0.0006
7	MEAN:	87.90	7.30	794.40	70082.81	5.817	17.51	1535.76	0.1275	21.07	1809.73	0.1502
	STD DEV:	3.50	0.29	113.93	12596.95	1.046	1.44	65.15	0.0054	19.04	1580.05	0.1311
9	MEAN:	57.43	5.74	1115.75	64188.58	6.419	26.55	1528.89	0.1529	3.84	219.47	0.0219
	STD DEV:	0.98	0.10	268.05	16118.73	1.612	10.83	639.98	0.0639	2.83	161.89	0.0162
10	MEAN:	26.40	1.77	933.48	24643.81	1.651	60.59	1599.64	0.1072	0.85	22.47	0.0015
	STD DEV:	0.0	0.00	11.20	297.83	0.020	2.66	70.22	0.0047	0.35	9.18	0.0006
TOTAL FOR CYCLE		MEAN:	20.525			18.871			0.664			0.1802
		STD DEV:	0.248			0.831			0.084			0.1153
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.919			0.032			0.0088
					STD DEV:	0.040			0.004			0.0057

ENGINE SUMMMARY SAMPLE NUMBER = 3.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	24.03	4.31	641.05	15421.49	3.084	47.22	1143.62	0.2287	0.94	23.61	0.0047
	STD DEV:	0.98	0.20	57.73	1749.54	0.350	31.99	800.47	0.1601	0.24	6.19	0.0012
6	MEAN:	110.20	0.55	929.09	102340.00	0.512	26.02	2376.39	0.0144	4.08	449.40	0.0022
	STD DEV:	1.05	0.01	143.65	15464.31	0.077	25.19	2795.91	0.0140	0.33	40.59	0.0002
7	MEAN:	100.23	8.32	857.69	88606.81	7.354	21.09	2245.49	0.1864	17.53	1711.02	0.1420
	STD DEV:	16.77	1.39	238.39	35983.90	2.978	17.94	2083.99	0.1730	12.94	1357.18	0.1126
9	MEAN:	53.90	5.39	897.35	48249.71	4.925	24.58	1368.45	0.1368	4.16	225.55	0.0226
	STD DEV:	3.65	0.37	51.72	1174.84	0.117	18.36	1114.50	0.1114	0.55	43.98	0.0044
10	MEAN:	25.80	1.73	628.62	15959.32	1.069	43.40	1057.96	0.0709	1.43	38.46	0.0026
	STD DEV:	3.65	0.24	108.87	930.96	0.062	32.35	680.39	0.0456	0.60	21.67	0.0015
TOTAL FOR CYCLE		MEAN:	20.796			16.845			0.637			0.1741
		STD DEV:	1.775			3.058			0.501			0.1108
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.805			0.030			0.0084
					STD DEV:	0.092			0.022			0.0052

MODEL SUMMARY SAMPLE NUMBER = 6.

TEST MODE		MEASURED FUEL FLOW LB/HR	FUEL USED LBS.	CO LB/1K LB FUEL	CO LB/1K HOURS	CO EMISSION LBS.	HC LB/1K LB FUEL	HC LB/1K HOURS	HC EMISSION LBS.	NO LB/1K LB FUEL	NO LB/1K HOURS	NO EMISSION LBS.
2	MEAN:	24.92	4.98	751.00	18834.70	3.767	49.21	1233.77	0.2468	0.73	19.33	0.0039
	STD DEV:	1.32	0.26	131.12	4162.88	0.833	20.52	525.50	0.1051	0.24	6.67	0.0013
6	MEAN:	110.78	0.55	944.56	104622.31	0.523	23.76	2534.41	0.0132	5.15	573.04	0.0029
	STD DEV:	1.94	0.01	92.52	10164.48	0.051	16.34	1411.92	0.0091	1.23	155.74	0.0008
7	MEAN:	86.07	7.31	826.04	79344.81	6.586	19.30	1890.62	0.1569	13.30	1760.37	0.1461
	STD DEV:	12.77	1.06	170.66	26105.00	2.167	11.55	1374.78	0.1141	14.63	1318.45	0.1094
9	MEAN:	55.67	5.57	1006.55	55219.14	5.622	25.57	1448.67	0.1449	4.03	222.51	0.0223
	STD DEV:	3.09	0.31	210.05	13442.16	1.344	13.52	817.24	0.0917	1.23	106.15	0.0106
10	MEAN:	26.10	1.75	781.05	20301.06	1.361	52.00	1329.80	0.0890	1.14	30.46	0.0020
	STD DEV:	2.33	0.16	180.76	4797.25	0.321	22.59	524.57	0.0351	0.54	17.27	0.0012
TOTAL FOR CYCLE		MEAN:	20.560			17.354			0.651			0.1271
		STD DEV:	1.193			2.291			0.321			0.1012
TOTAL FOR CYCLE/LB FUEL					MEAN:	0.862			0.031			0.0085
					STD DEV:	0.085			0.014			0.0049

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                                                  ANALYSIS OF VARIANCE

         WITHIN DEGREES OF FREEDOM =  1                     BETWEEN DEGREES OF FREEDOM =  4                         0540

TEST                  MEASURED     FUEL        CO          CO      CO          HC         HC          HC      NO         NO         NO
MODE                 FUEL FLOW     USED     LB/1K       LB/1K  EMISSION     LB/1K      LB/1K    EMISSION   LB/1K      LB/1K   EMISSION
                         LB/HR     LBS.   LB FUEL       HOURS    LBS.     LB FUEL      HOURS        LBS. LB FUEL      HOURS       LBS.

   2         MS AMONG:     4.68      0.19  72533.00 69901312.00  2.7961      23.75   48764.00    0.001951    0.23     109.47   0.000004
            MS WITHIN:     1.02      0.04   3358.75  4186624.00  0.1674     520.53  332990.25    0.013320    0.05      28.16   0.000001
              F RATIO:     4.58      4.59     21.60       16.70 16.6986       0.05       0.15    0.146447    4.85       3.89   3.887541
           VAR. AMONG:     1.22      0.05  23058.08 21904896.00  0.8762    -165.59  -94742.06   -0.003790    0.06      27.10   0.000001
           VAR. COMB.:     2.24      0.09  26416.83 26091520.00  1.0437     354.94  238248.19    0.009530    0.11      55.26   0.000002
              R INTRA:     0.54      0.54      0.87        0.84  0.8396      -0.47      -0.40   -0.397658    0.56       0.49   0.490449
            SIG COMB.:     1.50      0.30    162.53     5107.98  1.0216      18.84     488.11    0.097621    0.33       7.43   0.001487

   6         MS AMONG:     1.96      0.00   1440.00 31236096.00  0.0008      30.67  351328.00    0.000009    7.06   91730.44   0.000002
            MS WITHIN:     4.20      0.00  10339.75121336832.00  0.0030     326.18 4015988.00    0.000100    0.46    7384.89   0.000000
              F RATIO:     0.47      0.48      0.14        0.26  0.2573       0.09       0.09    0.087491   15.27      12.42  12.421752
           VAR. AMONG:    -0.74     -0.00  -2966.58-30033568.00 -0.0008     -98.50-1221553.00   -0.000031    2.20   28115.16   0.000001
           VAR. COMB.:     3.45      0.00   7373.16 91303264.00  0.0023     227.67 2794435.00    0.000070    2.66   35500.05   0.000001
              R INTRA:    -0.22     -0.21     -0.40       -0.33 -0.3290      -0.43      -0.44   -0.437132    0.83       0.79   0.791981
            SIG COMB.:     1.86      0.01     85.87     9555.27  0.0479      15.09    1671.66    0.008358    1.63     188.41   0.000942

   7         MS AMONG:   228.15      1.57   6008.00514695168.00  3.5458      19.18  755584.00    0.005205   18.79   14507.00   0.000101
            MS WITHIN:   146.70      1.31  34904.50723165184.00  4.9819     161.99 2173632.00    0.014974  264.93 2169252.00   0.014944
              F RATIO:     1.56      1.56      0.17        0.71  0.7117       0.12       0.35    0.347612    0.07       0.01   0.006735
           VAR. AMONG:    27.15      0.19  -9632.16-69490000.00 -0.4787     -47.60 -472682.63   -0.003256  -82.05 -718215.00  -0.004948
           VAR. COMB.:   173.85      1.20  25272.34653675008.00  4.5032     114.39 1700349.00    0.011718  182.88 1451037.00   0.009996
              R INTRA:     0.16      0.16     -0.38       -0.11 -0.1063      -0.42      -0.28   -0.277894   -0.45      -0.49  -0.494965
            SIG COMB.:    13.19      1.09    158.37    25567.07  2.1221      10.70    1304.20    0.108249   13.52    1204.59   0.099981

   9         MS AMONG:    18.74      0.19  71553.00381071360.00  3.8107       5.83   38607.00    0.000386    0.16      55.50   0.000001
            MS WITHIN:     7.15      0.07  37263.00130596864.00  1.3060     227.18  825201.75    0.008252    4.15   14071.08   0.000141
              F RATIO:     2.62      2.62      1.92        2.92  2.9178       0.03       0.05    0.046791    0.04       0.00   0.003927
           VAR. AMONG:     3.86      0.04  11430.00 83491488.00  0.8349     -73.78 -262198.25   -0.002622   -1.33   -4671.86  -0.000047
           VAR. COMB.:    11.01      0.11  48693.00214088352.00  2.1409     153.40  563003.50    0.005630    2.82    9399.22   0.000094
              R INTRA:     0.35      0.35      0.23        0.39  0.3900      -0.48      -0.47   -0.465709   -0.47      -0.50  -0.497061
            SIG COMB.:     3.32      0.33    220.66    14631.76  1.4632      12.39     750.34    0.075033    1.68      96.95   0.009695

  10         MS AMONG:     0.54      0.00 139416.00113157120.00  0.5080     443.32  440141.00    0.001976    0.51     383.60   0.000002
            MS WITHIN:     6.67      0.03   5989.50   477696.00  0.0021     526.84  233931.75    0.001050    0.24     277.08   0.000001
              F RATIO:     0.08      0.08     23.28      236.88237.2011       0.84       1.88    1.881470    2.10       1.38   1.384472
           VAR. AMONG:    -2.04     -0.01  44475.50 37559808.00  0.1686     -27.84   68736.38    0.000309    0.09      35.51   0.000000
           VAR. COMB.:     4.62      0.02  50465.00 38037504.00  0.1707     499.00  302668.13    0.001359    0.33     312.58   0.000001
              R INTRA:    -0.44     -0.44      0.88        0.99  0.9875      -0.06       0.23    0.227097    0.27       0.11   0.113599
            SIG COMB.:     2.15      0.14    224.64     6167.46  0.4132      22.34     550.15    0.036860    0.58      17.68   0.001185

TOTAL FOR CYCLE       MS AMONG:     0.110                        6.1599                              0.001099                     0.000055
                     MS WITHIN:     1.606                        5.0217                              0.128901                     0.012782
                       F RATIO:     0.068                        1.2267                              0.008523                     0.004300
                    VAR. AMONG:    -0.499                        0.3794                             -0.042601                    -0.004242
                    VAR. COMB.:     1.107                        5.4011                              0.086300                     0.008539
                       R INTRA:    -0.450                        0.0702                             -0.493635                    -0.496782
                     SIG COMB.:     1.052                        2.3240                              0.293769                     0.092409

TOTAL FOR CYCLE/LB FUEL                               MS AMONG:  0.0195                              0.000009                     0.000000
                                                     MS WITHIN:  0.0042                              0.000249                     0.000030
                                                       F RATIO:  4.6600                              0.036135                     0.006518
                                                    VAR. AMONG:  0.0051                             -0.000080                    -0.000010
                                                    VAR. COMB.:  0.0093                              0.000169                     0.000020
                                                       R INTRA:  0.5495                             -0.473380                    -0.495128
                                                     SIG COMB.:  0.0965                              0.012996                     0.004455
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APPENDIX III

ANALYSIS OF REPLICATE TESTS OF TURBINE/TURBOPROP ENGINES

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MODEL  JT3D P&W EXP.          SAMPLE NUMBER =    4.


MODE                 EMISSION      FUEL       TIME IN       CO         FUEL        LB CO /     ENERGY      LB CO /
                       RATE        RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.        LBS.

TAXI-IDLE   MEAN     91.812      891.147      19.00      29.074      282.20       99.455      332.50     0.08744
           STD DEV   41.304      242.312       0.0       13.079       76.73       22.414        0.0      0.03934

TAKEOFF     MEAN     17.087    12267.809       0.70       0.199      143.12        1.405      245.00     0.00081
           STD DEV   10.355      414.665       0.0        0.121        4.84        0.861        0.20     0.00049

CLIMBOUT    MEAN     12.200    10104.746       2.20       0.447      370.51        1.208      654.50     0.00068
           STD DEV    2.721      265.972       0.0        0.100        9.75        0.275        0.0      0.00015

APPROACH    MEAN     35.009     4635.438       4.00       2.334      309.03        7.551      560.00     0.00417
           STD DEV    4.506      142.511       0.0        0.300        9.50        0.949        0.0      0.00054

TAXI-IDLE   MEAN     91.812      891.147       7.00      10.711      103.97       99.455      122.50     0.08744
           STD DEV   41.304      242.312       0.0        4.819       28.27       22.414        0.14     0.03934

           TOTAL FOR CYCLE                    MEAN:  42.766     1208.82                  1914.50
                                          STD DEV:   17.847      108.22                     2.58

           LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:  34.712
                                          STD DEV:   11.871

           LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:  22.338
                                          STD DEV:    9.322

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.949
                                          STD DEV:    0.575


MODE                 EMISSION      FUEL       TIME IN       HC         FUEL        LB HC /     ENERGY      LB HC /
                       RATE        RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.        LBS.

TAXI-IDLE   MEAN     98.398      891.147      19.00      31.159      282.20      112.105      332.50     0.09371
           STD DEV   29.232      242.312       0.0        9.257       76.73       32.469        0.0      0.02784

TAKEOFF     MEAN      5.460    12267.809       0.70       0.064      143.12        0.450      245.00     0.00026
           STD DEV    4.726      414.665       0.0        0.055        4.84        0.397        0.20     0.00023

CLIMBOUT    MEAN      4.482    10104.746       2.20       0.164      370.51        0.446      654.50     0.00025
           STD DEV    4.628      265.972       0.0        0.170        9.75        0.466        0.0      0.00026

APPROACH    MEAN      5.946     4635.438       4.00       0.396      309.03        1.279      560.00     0.00071
           STD DEV    2.605      142.511       0.0        0.174        9.50        0.541        0.0      0.00031

TAXI-IDLE   MEAN     98.398      891.147       7.00      11.480      103.97      112.105      122.50     0.09371
           STD DEV   29.232      242.312       0.0        3.410       28.27       32.469        0.14     0.02784

           TOTAL FOR CYCLE                    MEAN:  43.263     1208.82                  1914.50
                                          STD DEV:   12.487      108.22                     2.58

           LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:  35.463
                                          STD DEV:    8.646

           LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:  22.598
                                          STD DEV:    6.522

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   3.033
                                          STD DEV:    2.675


MODE                 EMISSION      FUEL       TIME IN      NOX         FUEL        LB NOX/     ENERGY      LB NOX/
                       RATE        RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.        LBS.

TAXI-IDLE   MEAN      1.822      891.147      19.00       0.577      282.20        2.002      332.50     0.00174
           STD DEV    0.716      242.312       0.0        0.227       76.73        0.384        0.0      0.00068

TAKEOFF     MEAN    195.894    12267.809       0.70       2.285      143.12       15.981      245.00     0.00933
           STD DEV    5.216      414.665       0.0        0.061        4.84        0.659        0.20     0.00025

CLIMBOUT    MEAN    123.124    10104.746       2.20       4.515      370.51       12.187      654.50     0.00690
           STD DEV    6.143      265.972       0.0        0.225        9.75        0.583        0.0      0.00034

APPROACH    MEAN     26.939     4635.438       4.00       1.796      309.03        5.816      560.00     0.00321
           STD DEV    0.535      142.511       0.0        0.036        9.50        0.225        0.0      0.00006

TAXI-IDLE   MEAN      1.822      891.147       7.00       0.213      103.97        2.002      122.50     0.00174
           STD DEV    0.716      242.312       0.0        0.084       28.27        0.384        0.14     0.00068

           TOTAL FOR CYCLE                    MEAN:   9.386     1208.82                  1914.50
                                          STD DEV:    0.192      108.22                     2.58

           LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:   7.811
                                          STD DEV:    0.710

           LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:   4.902
                                          STD DEV:    0.100

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 108.830
                                          STD DEV:    2.897
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MODEL  JT8D P&W EXP.          SAMPLE NUMBER =   4.


MODE                  EMISSION     FUEL      TIME IN      CO          FUEL       LB CO /      ENERGY      LB CO /
                        RATE       RATE       MODE       MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.         LBS.


TAXI-IDLE   MEAN      60.276   1019.327      19.00     19.087       322.79       57.989      294.50     0.06481
          STD DEV     29.694     66.628      0.0        9.403        21.10       24.701        0.0      0.03193

TAKEOFF     MEAN      10.268   9438.395      0.70       0.120       110.11        1.085      180.83     0.00066
          STD DEV      6.653    185.444      0.0        0.078         2.17        0.698        0.0      0.00043

CLIMBOUT    MEAN      11.258   7796.668      2.20       0.413       285.88        1.442      483.08     0.00085
          STD DEV      6.225    102.424      0.0        0.228         3.75        0.793        0.0      0.00047

APPROACH    MEAN      20.977   3707.101      4.00       1.398       247.14        5.665      413.33     0.00338
          STD DEV      8.816     76.942      0.0        0.588         5.13        2.407        0.0      0.00142

TAXI-IDLE   MEAN      60.276   1019.327      7.00       7.032       118.92       57.989      108.50     0.06481
          STD DEV     29.694     66.628      0.0        3.464         7.77       24.701        0.10     0.03193

          TOTAL FOR CYCLE                        MEAN:  28.051      1084.84                  1480.25
                                             STD DEV:  12.303        36.52                     1.53

          LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:  25.631
                                             STD DEV:  10.467

          LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:  18.950
                                             STD DEV:   8.311

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.773
                                             STD DEV:   0.501


MODE                  EMISSION     FUEL      TIME IN      HC          FUEL       LB HC /      ENERGY      LB HC /
                        RATE       RATE       MODE       MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.         LBS.


TAXI-IDLE   MEAN       8.833   1019.327      19.00      2.797       322.79        8.481      294.50     0.00950
          STD DEV      5.825     66.628      0.0        1.845        21.10        5.031        0.0      0.00626

TAKEOFF     MEAN       2.059   9438.395      0.70       0.024       110.11        0.219      180.83     0.00013
          STD DEV      0.407    185.444      0.0        0.005         2.17        0.046        0.0      0.00003

CLIMBOUT    MEAN       1.816   7796.668      2.20       0.067       285.88        0.233      483.08     0.00014
          STD DEV      0.394    102.424      0.0        0.014         3.75        0.052        0.0      0.00003

APPROACH    MEAN       2.089   3707.101      4.00       0.139       247.14        0.564      413.33     0.00034
          STD DEV      0.485     76.942      0.0        0.032         5.13        0.132        0.0      0.00008

TAXI-IDLE   MEAN       8.833   1019.327      7.00       1.031       118.92        8.481      108.50     0.00950
          STD DEV      5.825     66.628      0.0        0.680         7.77        5.031        0.10     0.00626

          TOTAL FOR CYCLE                        MEAN:   4.058      1084.84                  1480.25
                                             STD DEV:   2.503        36.52                     1.53

          LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:   3.706
                                             STD DEV:   2.181

          LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   2.741
                                             STD DEV:   1.691

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   1.550
                                             STD DEV:   0.306


MODE                  EMISSION     FUEL      TIME IN      NOX         FUEL       LB NOX/      ENERGY      LB NOX/
                        RATE       RATE       MODE       MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.         LBS.


TAXI-IDLE   MEAN       3.046   1019.327      19.00      0.965       322.79        3.067      294.50     0.00328
          STD DEV      1.621     66.628      0.0        0.513        21.10        1.715        0.0      0.00174

TAKEOFF     MEAN     244.457   9438.395      0.70       2.852       110.11       25.923      180.83     0.01577
          STD DEV     16.430    185.444      0.0        0.191         2.17        2.049        0.0      0.00106

CLIMBOUT    MEAN     153.997   7796.668      2.20       5.647       285.88       19.768      483.08     0.01169
          STD DEV     12.961    102.424      0.0        0.475         3.75        1.889        0.0      0.00098

APPROACH    MEAN      31.557   3707.101      4.00       2.104       247.14        8.527      413.33     0.00509
          STD DEV      8.476     76.942      0.0        0.565         5.13        2.361        0.0      0.00137

TAXI-IDLE   MEAN       3.046   1019.327      7.00       0.355       118.92        3.067      108.50     0.00328
          STD DEV      1.621     66.628      0.0        0.189         7.77        1.715        0.10     0.00174

          TOTAL FOR CYCLE                        MEAN:  11.922      1084.84                  1480.25
                                             STD DEV:   1.668        36.52                     1.53

          LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:  11.037
                                             STD DEV:   1.893

          LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   8.054
                                             STD DEV:   1.127

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 184.007
                                             STD DEV:  12.344
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MODEL  JT9D P&W EXP.          SAMPLE NUMBER =   4.


MODE                EMISSION      FUEL       TIME IN       CO          FUEL        LB CO /     ENERGY      LB CO /
                      RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN    121.839     1901.306     19.00      38.582       602.08       63.954      964.25      0.04001
          STD DEV    31.634       52.786     0.0        10.017        16.70       15.624        0.0       0.01039

TAKEOFF     MEAN     10.585    17583.953     0.70        0.123       205.15        0.609      507.50      0.00024
          STD DEV     6.061      461.695     0.0         0.071         5.39        0.363        0.0       0.00014

CLIMBOUT    MEAN     12.817    14926.891     2.20        0.470       547.32        0.863     1355.75      0.00035
          STD DEV     4.204      316.784     0.0         0.154        11.62        0.301        1.00      0.00011

APPROACH    MEAN     26.340     5589.352     4.00        1.756       372.62        4.707      870.00      0.00202
          STD DEV     2.840      159.817     0.0         0.189        10.65        0.412        0.0       0.00022

TAXI-IDLE   MEAN    121.839     1901.306     7.00       14.214       221.82       63.954      355.25      0.04001
          STD DEV    31.634       52.786     0.0         3.691         6.16       15.624        0.0       0.01039

          TOTAL FOR CYCLE                      MEAN:    55.146      1948.99                  4052.75
                                           STD DEV:    13.828        33.14                     3.27

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    28.276
                                           STD DEV:     6.886

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:    13.607
                                           STD DEV:     3.412

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    0.284
                                           STD DEV:     0.163


MODE                EMISSION      FUEL       TIME IN       HC          FUEL        LB HC /     ENERGY      LB HC /
                      RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     37.164     1901.306     19.00      11.769       602.08       19.625      964.25      0.01220
          STD DEV    32.075       52.786     0.0        10.157        16.70       17.029        0.0       0.01053

TAKEOFF     MEAN      4.125    17583.953     0.70        0.048       205.15        0.234      507.50      0.00009
          STD DEV     1.705      461.695     0.0         0.020         5.39        0.104        0.0       0.00004

CLIMBOUT    MEAN      3.468    14926.891     2.20        0.127       547.32        0.233     1355.75      0.00009
          STD DEV     1.539      316.784     0.0         0.056        11.62        0.108        1.00      0.00004

APPROACH    MEAN      2.722     5589.352     4.00        0.181       372.62        0.491      870.00      0.00021
          STD DEV     1.950      159.817     0.0         0.130        10.65        0.361        0.0       0.00015

TAXI-IDLE   MEAN     37.164     1901.306     7.00        4.336       221.82       19.625      355.25      0.01220
          STD DEV    32.075       52.786     0.0         3.742         6.16       17.029        0.0       0.01053

          TOTAL FOR CYCLE                      MEAN:    16.461      1948.99                  4052.75
                                           STD DEV:    14.097        33.14                     3.27

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     8.515
                                           STD DEV:     7.420

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     4.062
                                           STD DEV:     3.478

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    1.106
                                           STD DEV:     0.457


MODE                EMISSION      FUEL       TIME IN      NOX          FUEL        LB NOX/     ENERGY      LB NOX/
                      RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN      5.872     1901.306     19.00       1.859       602.08        3.106      964.25      0.00193
          STD DEV     1.869       52.786     0.0         0.592        16.70        1.030        0.0       0.00061

TAKEOFF     MEAN    780.061    17583.953     0.70        9.101       205.15       44.208      507.50      0.01793
          STD DEV   181.698      461.695     0.0         2.120         5.39        9.331        0.0       0.00418

CLIMBOUT    MEAN    500.726    14926.891     2.20       18.360       547.32       33.471     1355.75      0.01354
          STD DEV    95.273      316.784     0.0         3.493        11.62        5.765        1.00      0.00258

APPROACH    MEAN     54.270     5589.352     4.00        3.618       372.62        9.715      870.00      0.00416
          STD DEV     5.900      159.817     0.0         0.393        10.65        1.071        0.0       0.00045

TAXI-IDLE   MEAN      5.872     1901.306     7.00        0.685       221.82        3.106      355.25      0.00193
          STD DEV     1.869       52.786     0.0         0.218         6.16        1.030        0.0       0.00061

          TOTAL FOR CYCLE                      MEAN:    33.623      1948.99                  4052.75
                                           STD DEV:     6.706        33.14                     3.27

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    17.260
                                           STD DEV:     3.451

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     8.296
                                           STD DEV:     1.655

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:  209.211
                                           STD DEV:    48.732
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MODEL  JT3C SRI REPS 631329  SAMPLE NUMBER =   2.


MODE                EMISSION     FUEL      TIME IN       CO         FUEL       LB CO /     ENERGY      LB CO /
                      RATE       RATE       MODE        MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.        LBS.


TAXI-IDLE   MEAN     51.620   1154.107     19.00      16.346      365.47      47.385     190.00      0.08603
            STD DEV  47.113    132.590     0.0        14.919       41.99      46.266       0.0       0.07852

TAKEOFF     MEAN      8.903  10527.086      0.70       0.104      122.82       0.840     140.00      0.00074
            STD DEV  12.590    100.955     0.0         0.147        1.18       1.188       0.20      0.00105

CLIMBOUT    MEAN      9.178   8780.414      2.20       0.337      321.95       1.043     374.00      0.00090
            STD DEV  12.979     24.331     0.0         0.476        0.87       1.475       0.0       0.00127

APPROACH    MEAN     21.241   4435.035      4.00       1.416      295.67       4.792     320.00      0.00443
            STD DEV   1.590     65.727     0.0         0.106        4.39       0.430       0.0       0.00033

TAXI-IDLE   MEAN     51.620   1154.107      7.00       6.022      134.65      47.385      70.00      0.08603
            STD DEV  47.113    132.590     0.0         5.496       15.47      46.266       0.0       0.07852

          TOTAL FOR CYCLE                     MEAN:   24.225     1240.55                 1094.00
                                          STD DEV:   20.932       51.01                    0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:   19.892
                                          STD DEV:   17.691

          LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:   22.144
                                          STD DEV:   19.134

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.866
                                          STD DEV:    1.224


MODE                EMISSION     FUEL      TIME IN       HC         FUEL       LB HC /     ENERGY      LB HC /
                      RATE       RATE       MODE        MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.        LBS.


TAXI-IDLE   MEAN     61.199   1154.107     19.00      19.380      365.47      56.830     190.00      0.10200
            STD DEV  68.867    132.590     0.0        21.808       41.99      66.201       0.0       0.11478

TAKEOFF     MEAN      1.487  10527.086      0.70       0.017      122.82       0.140     140.00      0.00012
            STD DEV   2.104    100.955     0.0         0.025        1.18       0.198       0.20      0.00018

CLIMBOUT    MEAN      1.190   8780.414      2.20       0.044      321.95       0.136     374.00      0.00012
            STD DEV   0.695     24.331     0.0         0.025        0.87       0.080       0.0       0.00007

APPROACH    MEAN      5.212   4435.035      4.00       0.347      295.67       1.179     320.00      0.00109
            STD DEV   2.415     65.727     0.0         0.161        4.39       0.562       0.0       0.00050

TAXI-IDLE   MEAN     61.199   1154.107      7.00       7.140      134.65      56.830      70.00      0.10200
            STD DEV  68.867    132.590     0.0         8.035       15.47      66.201       0.0       0.11478

          TOTAL FOR CYCLE                     MEAN:   26.928     1240.55                 1094.00
                                          STD DEV:   29.681       51.01                    0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:   22.217
                                          STD DEV:   24.839

          LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:   24.614
                                          STD DEV:   27.130

          LBS POLLUTANT/1000K LB TH-HR AT T.C.   MEAN:    1.446
                                          STD DEV:    2.045


MODE                EMISSION     FUEL      TIME IN      NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                      RATE       RATE       MODE        MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.        LBS.


TAXI-IDLE   MEAN      1.698   1154.107     19.00       0.538      365.47       1.483     190.00      0.00283
            STD DEV   0.028    132.590     0.0         0.009       41.99       0.194       0.0       0.00005

TAKEOFF     MEAN    119.986  10527.086      0.70       1.400      122.82      11.388     140.00      0.01000
            STD DEV  22.257    100.955     0.0         0.260        1.18       2.005       0.20      0.00185

CLIMBOUT    MEAN     33.807   8780.414      2.20       3.073      321.95       9.544     374.00      0.00822
            STD DEV   7.929     24.331     0.0         0.291        0.87       0.877       0.0       0.00078

APPROACH    MEAN     22.943   4435.035      4.00       1.530      295.67       5.173     320.00      0.00478
            STD DEV   0.515     65.727     0.0         0.034        4.39       0.039       0.0       0.00011

TAXI-IDLE   MEAN      1.698   1154.107      7.00       0.198      134.65       1.483      70.00      0.00283
            STD DEV   0.028    132.590     0.0         0.003       15.47       0.194       0.0       0.00005

          TOTAL FOR CYCLE                     MEAN:    6.738     1240.55                 1094.00
                                          STD DEV:    0.597       51.01                    0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:    5.446
                                          STD DEV:    0.705

          LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:    6.159
                                          STD DEV:    0.545

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  115.653
                                          STD DEV:   21.639
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MODEL  CJ805 SR REPS 161302  SAMPLE NUMBER =   2.


MODE                 EMISSION      FUEL       TIME IN        CO          FUEL       LB CO /      ENERGY      LB CO /
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                       LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE   MEAN     47.536      911.666      19.00       15.053       288.69       52.223       141.87     0.10611
            STD DEV   0.868       43.417      0.0          0.275        13.75        3.439         0.09     0.00194

TAKEOFF     MEAN     27.195    10028.430       0.70        0.317       117.00        2.711       130.67     0.00243
            STD DEV   1.423      320.250      0.0          0.017         3.74        0.055         0.23     0.00013

CLIMBOUT    MEAN     25.579     8451.645       2.20        0.938       309.89        3.028       349.07     0.00269
            STD DEV   0.394      181.373      0.0          0.014         6.66        0.112          0.0     0.00004

APPROACH    MEAN     37.537     3617.816       4.00        2.502       241.19       10.357       298.67     0.00838
            STD DEV   4.534      255.437      0.0          0.302        17.03        0.522          0.0     0.00101

TAXI-IDLE   MEAN     47.536      911.666       7.00        5.546       106.36       52.223        52.27     0.10611
            STD DEV   0.868       43.417      0.0          0.101         5.07        3.439          0.0     0.00194

           TOTAL FOR CYCLE                        MEAN:  24.356      1063.13                    972.53
                                              STD DEV:    0.676        12.17                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:  22.915
                                              STD DEV:    0.898

           LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:  25.044
                                              STD DEV:    0.695

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   2.833
                                              STD DEV:    0.148


MODE                 EMISSION      FUEL       TIME IN        HC          FUEL       LB HC /      ENERGY      LB HC /
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                       LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE   MEAN     20.596      911.666      19.00        6.522       288.69       22.514       141.87     0.04597
            STD DEV   3.967       43.417      0.0          1.256        13.75        3.280         0.09     0.00886

TAKEOFF     MEAN      0.257    10028.430       0.70        0.003       117.00        0.026       130.67     0.00002
            STD DEV   0.347      320.250      0.0          0.004         3.74        0.035         0.23     0.00003

CLIMBOUT    MEAN      0.816     8451.645       2.20        0.030       309.89        0.097       349.07     0.00009
            STD DEV   0.604      181.373      0.0          0.022         6.66        0.074          0.0     0.00006

APPROACH    MEAN      2.931     3617.816       4.00        0.195       241.19        0.829       298.67     0.00065
            STD DEV   1.758      255.437      0.0          0.117        17.03        0.545          0.0     0.00039

TAXI-IDLE   MEAN     20.596      911.666       7.00        2.403       106.36       22.514        52.27     0.04597
            STD DEV   3.967       43.417      0.0          0.463         5.07        3.280          0.0     0.00886

           TOTAL FOR CYCLE                        MEAN:   9.153      1063.13                    972.53
                                              STD DEV:    1.810        12.17                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:   8.601
                                              STD DEV:    1.604

           LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   9.412
                                              STD DEV:    1.861

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.268
                                              STD DEV:    0.362


MODE                 EMISSION      FUEL       TIME IN       NOX          FUEL       LB NOX/      ENERGY      LB NOX/
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                       LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE   MEAN      1.545      911.666      19.00        0.489       288.69        1.696       141.87     0.00345
            STD DEV   0.035       43.417      0.0          0.011        13.75        0.042         0.09     0.00008

TAKEOFF     MEAN    109.962    10028.430       0.70        1.283       117.00       10.958       130.67     0.00982
            STD DEV   7.869      320.250      0.0          0.092         3.74        0.435         0.23     0.00070

CLIMBOUT    MEAN     81.784     8451.645       2.20        2.999       309.89        9.674       349.07     0.00859
            STD DEV   3.932      181.373      0.0          0.144         6.66        0.258          0.0     0.00041

APPROACH    MEAN     17.742     3617.816       4.00        1.183       241.19        4.906       298.67     0.00396
            STD DEV   1.017      255.437      0.0          0.068        17.03        0.065          0.0     0.00023

TAXI-IDLE   MEAN      1.545      911.666       7.00        0.180       106.36        1.696        52.27     0.00345
            STD DEV   0.035       43.417      0.0          0.004         5.07        0.042          0.0     0.00008

           TOTAL FOR CYCLE                        MEAN:   6.134      1063.13                    972.53
                                              STD DEV:    0.183        12.17                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:   5.769
                                              STD DEV:    0.106

           LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   6.307
                                              STD DEV:    0.188

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 114.544
                                              STD DEV:    8.197
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MODEL  CJ805 SR REPS 161108  SAMPLE NUMBER =   4.

MODE               EMISSION      FUEL       TIME IN        CO          FUEL        LB CO /     ENERGY      LB CO /
                     RATE        RATE        MODE         MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE  MEAN     64.406      989.943      19.00       20.395       313.48       65.045      141.87     0.14376
           STD DEV  10.288      156.802      0.0          3.258        49.65        1.685        0.20     0.02297

TAKEOFF    MEAN     31.433     9801.734      0.70         0.367       114.35        3.202      130.67     0.00281
           STD DEV   4.817      185.444      0.0          0.056         2.17        0.451        0.14     0.00043

CLIMBOUT   MEAN     31.987     8150.773      2.20         1.173       298.86        3.921      349.07     0.00336
           STD DEV   4.009      105.805      0.0          0.147         3.87        0.448        0.0      0.00042

APPROACH   MEAN     37.259     3875.177      4.00         2.484       258.34        9.579      298.67     0.00832
           STD DEV  13.078      109.861      0.0          0.872         7.32        3.171        0.0      0.00292

TAXI-IDLE  MEAN     64.406      989.943      7.00         7.514       115.49       65.045       52.27     0.14376
           STD DEV  10.288      156.802      0.0          1.200        18.29        1.685        0.0      0.02296

        TOTAL FOR CYCLE                          MEAN:   31.933      1100.54                   972.53
                                             STD DEV:     4.954        70.24                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   28.887
                                             STD DEV:     2.820

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   32.834
                                             STD DEV:     5.094

        LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:    3.274
                                             STD DEV:     0.502

MODE               EMISSION      FUEL       TIME IN        HC          FUEL        LB HC /     ENERGY      LB HC /
                     RATE        RATE        MODE         MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE  MEAN     28.862      989.943      19.00        9.140       313.48       29.108      141.87     0.06442
           STD DEV   5.464      156.802      0.0          1.730        49.65        2.659        0.20     0.01220

TAKEOFF    MEAN      0.417     9801.734      0.70         0.005       114.35        0.043      130.67     0.00004
           STD DEV   0.540      185.444      0.0          0.006         2.17        0.055        0.14     0.00005

CLIMBOUT   MEAN      0.334     8150.773      2.20         0.014       298.86        0.047      349.07     0.00004
           STD DEV   0.464      105.805      0.0          0.017         3.87        0.057        0.0      0.00005

APPROACH   MEAN      3.124     3875.177      4.00         0.208       258.34        0.801      298.67     0.00070
           STD DEV   2.002      109.861      0.0          0.133         7.32        0.497        0.0      0.00045

TAXI-IDLE  MEAN     28.862      989.943      7.00         3.367       115.49       29.108       52.27     0.06442
           STD DEV   5.464      156.802      0.0          0.638        18.29        2.653        0.0      0.01220

        TOTAL FOR CYCLE                          MEAN:   12.734      1100.54                   972.53
                                             STD DEV:     2.349        70.24                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   11.516
                                             STD DEV:     1.622

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   13.094
                                             STD DEV:     2.416

        LBS POLLUTANT/1000K LB TH-HR AT T.C.     MEAN:    0.435
                                             STD DEV:     0.563

MODE               EMISSION      FUEL       TIME IN       NOX          FUEL        LB NOX/     ENERGY      LB NOX/
                     RATE        RATE        MODE         MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR       MIN.         LBS.         LBS.

TAXI-IDLE  MEAN      1.347      989.943      19.00        0.439       313.48        1.372      141.87     0.00310
           STD DEV   0.573      156.802      0.0          0.181        49.65        0.395        0.20     0.00128

TAKEOFF    MEAN     99.560     9801.734      0.70         1.162       114.35       10.159      130.67     0.00889
           STD DEV   4.471      185.444      0.0          0.052         2.17        0.474        0.14     0.00040

CLIMBOUT   MEAN     69.097     8150.773      2.20         2.534       298.86        8.480      349.07     0.00726
           STD DEV   2.058      105.805      0.0          0.075         3.87        0.324        0.0      0.00022

APPROACH   MEAN     18.330     3875.177      4.00         1.222       258.34        4.725      298.67     0.00409
           STD DEV   1.647      109.861      0.0          0.112         7.32        0.326        0.0      0.00038

TAXI-IDLE  MEAN      1.347      989.943      7.00         0.162       115.49        1.372       52.27     0.00310
           STD DEV   0.573      156.802      0.0          0.067        18.29        0.395        0.0      0.00128

        TOTAL FOR CYCLE                          MEAN:    5.518      1100.54                   972.53
                                             STD DEV:     0.350        70.24                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:    5.019
                                             STD DEV:     0.243

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:    5.674
                                             STD DEV:     0.359

        LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:  103.709
                                             STD DEV:     4.657
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MODEL  CJ805 SR REPS TW2220  SAMPLE NUMBER =   3.


MODE                EMISSION     FUEL       TIME IN      CO        FUEL       LB CO /     ENERGY     LB CO /
                      RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN     63.663    1286.913     19.00     20.160     407.52       49.135     277.08     0.07276
            STD DEV  14.172     110.935      0.0       4.488      35.13        7.051       0.0      0.01620

TAKEOFF     MEAN     20.246   15622.656      0.70      0.236     182.26        1.294     204.17     0.00116
            STD DEV   3.930     375.915      0.0       0.046       4.39        0.232       0.0      0.00022

CLIMBOUT    MEAN     19.632   13193.387      2.20      0.720     483.76        1.488     545.42     0.00132
            STD DEV   1.328     114.822      0.0       0.049       4.23        0.090       0.0      0.00009

APPROACH    MEAN     32.863    6028.520      4.00      2.191     401.90        5.456     466.67     0.00469
            STD DEV   4.408      53.516      0.0       0.294       3.55        0.781       0.0      0.00063

TAXI-IDLE   MEAN     63.663    1286.913      7.00      7.427     150.14       49.135     102.08     0.07276
            STD DEV  14.172     110.935      0.0       1.653      12.94        7.051       0.11     0.01620

         TOTAL FOR CYCLE                          MEAN:  30.734    1625.58                  1595.41
                                              STD DEV:   5.824      43.96                     2.12

         LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:  18.859
                                              STD DEV:   3.121

         LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:  19.264
                                              STD DEV:   3.650

         LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   1.350
                                              STD DEV:   0.262


MODE                EMISSION     FUEL       TIME IN      HC        FUEL       LB HC /     ENERGY     LB HC /
                      RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN     56.488    1286.913     19.00     17.888     407.52       44.453     277.08     0.06456
            STD DEV   8.599     110.935      0.0       2.723      35.13       10.565       0.0      0.00983

TAKEOFF     MEAN      1.796   15622.656      0.70      0.021     182.26        0.115     204.17     0.00010
            STD DEV   0.177     375.915      0.0       0.002       4.39        0.011       0.0      0.00001

CLIMBOUT    MEAN      3.396   13193.387      2.20      0.125     483.76        0.257     545.42     0.00023
            STD DEV   2.217     114.822      0.0       0.081       4.23        0.167       0.0      0.00015

APPROACH    MEAN      4.901    6028.520      4.00      0.327     401.90        0.812     466.67     0.00070
            STD DEV   1.416      53.516      0.0       0.094       3.55        0.228       0.0      0.00020

TAXI-IDLE   MEAN     56.488    1286.913      7.00      6.590     150.14       44.453     102.08     0.06456
            STD DEV   8.599     110.935      0.0       1.003      12.94       10.565       0.11     0.00983

         TOTAL FOR CYCLE                          MEAN:  24.950    1625.58                  1595.41
                                              STD DEV:   3.742      43.96                     2.12

         LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:  15.392
                                              STD DEV:   2.707

         LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:  15.639
                                              STD DEV:   2.345

         LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   1.198
                                              STD DEV:   0.118


MODE                EMISSION     FUEL       TIME IN      NOX       FUEL       LB NOX/     ENERGY     LB NOX/
                      RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN      2.345    1286.913     19.00      0.743     407.52        1.815     277.08     0.00268
            STD DEV   0.377     110.935      0.0       0.119      35.13        0.142       0.0      0.00043

TAKEOFF     MEAN    241.767   15622.656      0.70      2.821     182.26       15.482     204.17     0.01382
            STD DEV  10.256     375.915      0.0       0.120       4.39        0.782       0.0      0.00059

CLIMBOUT    MEAN    156.150   13193.387      2.20      5.725     483.76       11.836     545.42     0.01050
            STD DEV   3.132     114.822      0.0       0.115       4.23        0.242       0.0      0.00021

APPROACH    MEAN     33.460    6028.520      4.00      2.231     401.90        5.550     466.67     0.00478
            STD DEV   1.047      53.516      0.0       0.070       3.55        0.151       0.0      0.00015

TAXI-IDLE   MEAN      2.345    1286.913      7.00      0.274     150.14        1.815     102.08     0.00268
            STD DEV   0.377     110.935      0.0       0.044      12.94        0.142       0.11     0.00043

         TOTAL FOR CYCLE                          MEAN:  11.793    1625.58                  1595.41
                                              STD DEV:   0.322      43.96                     2.12

         LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   7.258
                                              STD DEV:   0.252

         LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   7.392
                                              STD DEV:   0.202

         LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN: 161.178
                                              STD DEV:   6.840
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MODEL  JT8D U-S REPS 665244  SAMPLE NUMBER =   2.

MODE                 EMISSION      FUEL       TIME IN       CO          FUEL        LB CO /     ENERGY      LB CO /
                       RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     45.500     968.896       19.00      14.408       306.82       46.438      275.50     0.05230
            STD DEV  17.997      65.628        0.0        5.699        20.78       15.429        0.0      0.02069

TAKEOFF     MEAN      7.184    9020.762        0.70       0.084       105.24        0.796      169.17     0.00050
            STD DEV   0.778      21.166        0.0        0.009         0.23        0.085        0.27     0.00005

CLIMBOUT    MEAN      6.767    7310.188        2.20       0.248       268.04        0.926      451.92     0.00055
            STD DEV   0.463     299.626        0.0        0.017        10.99        0.101        0.0      0.00004

APPROACH    MEAN      3.890    3817.285        4.00       0.259       254.49        1.020      386.67     0.00067
            STD DEV   0.750      52.154        0.0        0.050         3.46        0.210        0.0      0.00013

TAXI-IDLE   MEAN     45.500     968.896        7.00       5.308       113.04       46.438      101.50     0.05230
            STD DEV  17.997      65.628        0.0        2.100         7.66       15.429        0.0      0.02069

         TOTAL FOR CYCLE                       MEAN:     20.308      1047.62                  1384.75
                                            STD DEV:      7.756        20.66                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     19.315
                                            STD DEV:      7.023

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     14.665
                                            STD DEV:      5.601

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:      0.578
                                            STD DEV:      0.063


MODE                 EMISSION      FUEL       TIME IN       HC          FUEL        LB HC /     ENERGY      LB HC /
                       RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     16.860     968.896       19.00       5.339       306.82       16.818      275.50     0.01938
            STD DEV  17.778      65.628        0.0        5.630        20.78       17.210        0.0      0.02043

TAKEOFF     MEAN      0.038    9020.762        0.70       0.000       105.24        0.004      169.17     0.00000
            STD DEV   0.054      21.166        0.0        0.001         0.23        0.006        0.27     0.00000

CLIMBOUT    MEAN      0.236    7310.188        2.20       0.009       268.04        0.033      451.92     0.00002
            STD DEV   0.334     299.626        0.0        0.012        10.99        0.047        0.0      0.00003

APPROACH    MEAN      0.405    3817.285        4.00       0.027       254.49        0.106      386.67     0.00007
            STD DEV   0.356      52.154        0.0        0.024         3.46        0.092        0.0      0.00006

TAXI-IDLE   MEAN     16.860     968.896        7.00       1.967       113.04       16.818      101.50     0.01938
            STD DEV  17.778      65.628        0.0        2.074         7.66       17.210        0.0      0.02043

         TOTAL FOR CYCLE                       MEAN:      7.342      1047.62                  1384.75
                                            STD DEV:      7.741        20.66                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      6.937
                                            STD DEV:      7.252

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      5.302
                                            STD DEV:      5.590

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:      0.031
                                            STD DEV:      0.043


MODE                 EMISSION      FUEL       TIME IN       NOX         FUEL        LB NOX/     ENERGY      LB NOX/
                       RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN      1.758     968.896       19.00       0.557       306.82        1.837      275.50     0.00202
            STD DEV   0.522      65.628        0.0        0.165        20.78        0.663        0.0      0.00060

TAKEOFF     MEAN    143.214    9020.762        0.70       1.671       105.24       15.875      169.17     0.00988
            STD DEV  10.067      21.166        0.0        0.117         0.23        1.080        0.27     0.00069

CLIMBOUT    MEAN     95.568    7310.188        2.20       3.504       268.04       13.052      451.92     0.00775
            STD DEV  11.513     299.626        0.0        0.422        10.99        1.040        0.0      0.00093

APPROACH    MEAN     23.176    3817.285        4.00       1.545       254.49        6.074      386.67     0.00400
            STD DEV   1.366      52.154        0.0        0.090         3.46        0.435        0.0      0.00023

TAXI-IDLE   MEAN      1.758     968.896        7.00       0.205       113.04        1.837      101.50     0.00202
            STD DEV   0.522      65.628        0.0        0.061         7.66        0.663        0.0      0.00060

         TOTAL FOR CYCLE                       MEAN:      7.482      1047.62                  1384.75
                                            STD DEV:      0.856        20.66                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      7.151
                                            STD DEV:      0.958

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      5.403
                                            STD DEV:      0.618

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    115.229
                                            STD DEV:      8.099
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MODEL  JT8D U-S RFPS 665165  SAMPLE NUMBER =   2.


MODE                EMISSION     FUEL      TIME IN      CO         FUEL        LB CO /      ENERGY      LB CO /
                      RATE       RATE       MODE       MASS        MASS      1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR      MIN.       LBS.        LBS.

TAXI-IDLE  MEAN      25.708     735.095     19.00      8.141      232.78       34.965      275.50     0.02955
           STD DEV    1.671       5.196     0.0        0.529        1.64        2.028        0.0      0.00192

TAKEOFF    MEAN       6.074    8530.191      0.70      0.071       99.52        0.716      169.17     0.00042
           STD DEV    1.919     241.793     0.0        0.022        2.82        0.245        0.27     0.00013

CLIMBOUT   MEAN       6.738    7023.316      2.20      0.247      257.52        0.960      451.92     0.00055
           STD DEV    0.827      46.648     0.0        0.030        1.68        0.124        0.0      0.00007

APPROACH   MEAN      15.503    3184.645      4.00      1.034      212.31        4.902      386.67     0.00267
           STD DEV    0.027     379.768     0.0        0.002       25.32        0.577        0.0      0.00001

TAXI-IDLE  MEAN      25.708     735.095      7.00      2.999       85.76       34.965      101.50     0.02955
           STD DEV    1.671       5.196     0.0        0.195        0.60        2.028        0.0      0.00192

           TOTAL FOR CYCLE                   MEAN:    12.492      887.89                  1384.75
                                         STD DEV:      0.673       32.08                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE    MEAN:    14.064
                                         STD DEV:      0.250

           LBS POLLUTANT/1K LB TH-HR/CYCLE   MEAN:     9.021
                                         STD DEV:      0.486

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.489
                                         STD DEV:      0.154


MODE                EMISSION     FUEL      TIME IN      HC         FUEL        LB HC /      ENERGY      LB HC /
                      RATE       RATE       MODE       MASS        MASS      1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR      MIN.       LBS.        LBS.

TAXI-IDLE  MEAN       5.065     735.095     19.00      1.604      232.78        6.892      275.50     0.00582
           STD DEV    0.153       5.196     0.0        0.048        1.64        0.256        0.0      0.00018

TAKEOFF    MEAN       0.074    8530.191      0.70      0.001       99.52        0.009      169.17     0.00001
           STD DEV    0.105     241.793     0.0        0.001        2.82        0.012        0.27     0.00001

CLIMBOUT   MEAN       0.239    7023.316      2.20      0.009      257.52        0.034      451.92     0.00002
           STD DEV    0.175      46.648     0.0        0.006        1.68        0.025        0.0      0.00001

APPROACH   MEAN       0.510    3184.645      4.00      0.034      212.31        0.151      386.67     0.00009
           STD DEV    0.570     379.768     0.0        0.038       25.32        0.161        0.0      0.00010

TAXI-IDLE  MEAN       5.065     735.095      7.00      0.591       85.76        6.892      101.50     0.00582
           STD DEV    0.153       5.196     0.0        0.018        0.60        0.256        0.0      0.00018

           TOTAL FOR CYCLE                   MEAN:     2.239      887.89                  1384.75
                                         STD DEV:      0.021       32.08                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE    MEAN:     2.523
                                         STD DEV:      0.114

           LBS POLLUTANT/1K LB TH-HR/CYCLE   MEAN:     1.617
                                         STD DEV:      0.015

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.060
                                         STD DEV:      0.084


MODE                EMISSION     FUEL      TIME IN      NOX        FUEL        LB NOX/      ENERGY      LB NOX/
                      RATE       RATE       MODE       MASS        MASS      1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR      MIN.       LBS.        LBS.

TAXI-IDLE  MEAN       1.324     735.095     19.00      0.419      232.78        1.802      275.50     0.00152
           STD DEV    0.030       5.196     0.0        0.009        1.64        0.053        0.0      0.00003

TAKEOFF    MEAN     102.462    8530.191      0.70      1.195       99.52       12.007      169.17     0.00707
           STD DEV    5.488     241.793     0.0        0.064        2.82        0.303        0.27     0.00038

CLIMBOUT   MEAN      73.183    7023.316      2.20      2.683      257.52       10.419      451.92     0.00594
           STD DEV    2.870      46.648     0.0        0.105        1.68        0.340        0.0      0.00023

APPROACH   MEAN      16.269    3184.645      4.00      1.085      212.31        5.100      386.67     0.00280
           STD DEV    2.381     379.768     0.0        0.159       25.32        0.139        0.0      0.00041

TAXI-IDLE  MEAN       1.324     735.095      7.00      0.155       85.76        1.802      101.50     0.00152
           STD DEV    0.030       5.196     0.0        0.003        0.60        0.053        0.0      0.00003

           TOTAL FOR CYCLE                   MEAN:     5.537      887.89                  1384.75
                                         STD DEV:      0.315       32.08                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE    MEAN:     6.234
                                         STD DEV:      0.130

           LBS POLLUTANT/1K LB TH-HR/CYCLE   MEAN:     3.999
                                         STD DEV:      0.227

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   82.440
                                         STD DEV:      4.415
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MODEL  JT8D U-S REPS 674250  SAMPLE NUMBER =   2.


MODE                EMISSION     FUEL       TIME IN       CO          FUEL       LB CO /     ENERGY      LB CO /
                      RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE  MEAN     36.603     857.740      19.00      11.591       271.62      42.589      275.50     0.04207
           STD DEV   4.816      40.175      0.0         1.525        12.72       3.620        0.0      0.00554

TAKEOFF    MEAN      4.853    8712.180       0.70       0.057       101.64       0.555      169.17     0.00033
           STD DEV   1.915     163.805      0.0         0.022         1.91       0.209        0.27     0.00013

CLIMBOUT   MEAN      4.483    7080.656       2.20       0.164       259.62       0.633      451.92     0.00036
           STD DEV   0.165      14.967      0.0         0.006         0.56       0.022        0.0      0.00001

APPROACH   MEAN     15.335    3589.559       4.00       1.022       239.30       4.270      386.67     0.00264
           STD DEV   0.955      53.814      0.0         0.064         3.58       0.202        0.0      0.00016

TAXI-IDLE  MEAN     36.603     857.740       7.00       4.270       100.07      42.589      101.50     0.04207
           STD DEV   4.816      40.175      0.0         0.562         4.69       3.620        0.0      0.00554

         TOTAL FOR CYCLE                    MEAN:     17.105       972.26                  1384.75
                                        STD DEV:       2.039        15.23                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:     17.578
                                        STD DEV:       1.822

         LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:     12.352
                                        STD DEV:       1.473

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  0.390
                                        STD DEV:       0.154


MODE                EMISSION     FUEL       TIME IN       HC          FUEL       LB HC /     ENERGY      LB HC /
                      RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE  MEAN      9.576     857.740      19.00       3.032       271.62      11.181      275.50     0.01101
           STD DEV   0.177      40.175      0.0         0.056        12.72       0.730        0.0      0.00020

TAKEOFF    MEAN      0.417    8712.180       0.70       0.005       101.64       0.048      169.17     0.00003
           STD DEV   0.351     163.805      0.0         0.004         1.91       0.041        0.27     0.00002

CLIMBOUT   MEAN      0.495    7080.656       2.20       0.018       259.62       0.070      451.92     0.00004
           STD DEV   0.322      14.967      0.0         0.012         0.56       0.045        0.0      0.00003

APPROACH   MEAN      0.806    3589.559       4.00       0.054       239.30       0.224      386.67     0.00014
           STD DEV   0.534      53.814      0.0         0.036         3.58       0.145        0.0      0.00009

TAXI-IDLE  MEAN      9.576     857.740       7.00       1.117       100.07      11.181      101.50     0.01101
           STD DEV   0.177      40.175      0.0         0.021         4.69       0.730        0.0      0.00020

         TOTAL FOR CYCLE                    MEAN:      4.226       972.26                  1384.75
                                        STD DEV:       0.128        15.23                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:      4.349
                                        STD DEV:       0.200

         LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:      3.052
                                        STD DEV:       0.092

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  0.335
                                        STD DEV:       0.283


MODE                EMISSION     FUEL       TIME IN      NOX          FUEL       LB NOX/     ENERGY      LB NOX/
                      RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE  MEAN      1.767     857.740      19.00       0.560       271.62       2.069      275.50     0.00203
           STD DEV   0.222      40.175      0.0         0.070        12.72       0.355        0.0      0.00025

TAKEOFF    MEAN    136.413    8712.180       0.70       1.591       101.64      15.665      169.17     0.00941
           STD DEV   4.190     163.805      0.0         0.049         1.91       0.775        0.27     0.00029

CLIMBOUT   MEAN     86.176    7080.656       2.20       3.160       259.62      12.170      451.92     0.00699
           STD DEV   1.435      14.967      0.0         0.053         0.56       0.179        0.0      0.00012

APPROACH   MEAN     14.560    3589.559       4.00       0.971       239.30       4.059      386.67     0.00251
           STD DEV   1.056      53.814      0.0         0.070         3.58       0.355        0.0      0.00018

TAXI-IDLE  MEAN      1.767     857.740       7.00       0.206       100.07       2.069      101.50     0.00203
           STD DEV   0.222      40.175      0.0         0.026         4.69       0.355        0.0      0.00025

         TOTAL FOR CYCLE                    MEAN:      6.488       972.26                  1384.75
                                        STD DEV:       0.127        15.23                     0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE     MEAN:      6.675
                                        STD DEV:       0.235

         LBS POLLUTANT/1K LB TH-HR/CYCLE    MEAN:      4.685
                                        STD DEV:       0.092

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 109.757
                                        STD DEV:       3.367
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MODEL  JT8D U-S REPS 674379  SAMPLE NUMBER =   2.


MODE                EMISSION      FUEL        TIME IN       CO          FUEL       LB CO /     ENERGY      LB CO /
                      RATE        RATE         MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN    32.637      764.329       19.00      10.335       242.04       42.741      275.50     0.03751
          STD DEV    0.888       24.597        0.0        0.281         7.79        2.537        0.0      0.00102

TAKEOFF     MEAN     7.992     8633.105        0.70       0.093       100.72        0.927      169.17     0.00055
          STD DEV    1.694      101.430        0.0        0.020         1.18        0.207        0.27     0.00012

CLIMBOUT    MEAN     7.868     7214.418        2.20       0.288       264.53        1.093      451.92     0.00064
          STD DEV    3.545       63.372        0.0        0.130         2.33        0.501        0.0      0.00029

APPROACH    MEAN    12.851     3354.975        4.00       0.857       223.67        3.846      386.67     0.00222
          STD DEV    3.230       96.333        0.0        0.215         6.42        1.073        0.0      0.00056

TAXI-IDLE   MEAN    32.637      764.329        7.00       3.808        89.17       42.741      101.50     0.03751
          STD DEV    0.888       24.597        0.0        0.104         2.87        2.537        0.0      0.00102

          TOTAL FOR CYCLE                      MEAN:     15.381       920.12                  1384.75
                                           STD DEV:      0.022         0.0                       0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     16.716
                                           STD DEV:      0.035

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     11.108
                                           STD DEV:      0.022

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      0.643
                                           STD DEV:      0.136


MODE                EMISSION      FUEL        TIME IN       HC          FUEL       LB HC /     ENERGY      LB HC /
                      RATE        RATE         MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN    10.697      764.329       19.00       3.387       242.04       13.982      275.50     0.01229
          STD DEV    0.958       24.597        0.0        0.303         7.79        0.804        0.0      0.00110

TAKEOFF     MEAN     0.0       8633.105        0.70       0.0         100.72        0.0        169.17     0.0
          STD DEV    0.0        101.430        0.0        0.0           1.18        0.0          0.27     0.0

CLIMBOUT    MEAN     0.109     7214.418        2.20       0.004       264.53        0.015      451.92     0.00001
          STD DEV    0.154       63.372        0.0        0.006         2.33        0.021        0.0      0.00001

APPROACH    MEAN     0.812     3354.975        4.00       0.054       223.67        0.243      386.67     0.00014
          STD DEV    0.286       96.333        0.0        0.019         6.42        0.092        0.0      0.00005

TAXI-IDLE   MEAN    10.697      764.329        7.00       1.248        89.17       13.982      101.50     0.01229
          STD DEV    0.958       24.597        0.0        0.112         2.87        0.804        0.0      0.00110

          TOTAL FOR CYCLE                      MEAN:      4.693       920.12                  1384.75
                                           STD DEV:      0.429         0.0                       0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      5.101
                                           STD DEV:      0.462

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      3.389
                                           STD DEV:      0.309

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      0.0
                                           STD DEV:      0.0


MODE                EMISSION      FUEL        TIME IN      NOX          FUEL       LB NOX/     ENERGY      LB NOX/
                      RATE        RATE         MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     2.393      764.329       19.00       0.758       242.04        3.097      275.50     0.00275
          STD DEV    1.699       24.597        0.0        0.538         7.79        2.123        0.0      0.00195

TAKEOFF     MEAN   180.366     8633.105        0.70       2.104       100.72       20.946      169.17     0.01244
          STD DEV   76.259      101.430        0.0        0.890         1.18        9.080        0.27     0.00526

CLIMBOUT    MEAN   115.365     7214.418        2.20       4.230       264.53       16.022      451.92     0.00936
          STD DEV   50.762       63.372        0.0        1.861         2.33        7.177        0.0      0.00412

APPROACH    MEAN    26.739     3354.975        4.00       1.787       223.67        8.042      386.67     0.00462
          STD DEV   11.926       96.333        0.0        0.795         6.42        3.785        0.0      0.00206

TAXI-IDLE   MEAN     2.393      764.329        7.00       0.279        89.17        3.097      101.50     0.00275
          STD DEV    1.699       24.597        0.0        0.198         2.87        2.123        0.0      0.00195

          TOTAL FOR CYCLE                      MEAN:      9.158       920.12                  1384.75
                                           STD DEV:      4.292         0.0                       0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      9.951
                                           STD DEV:      4.646

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      6.613
                                           STD DEV:      3.092

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    145.122
                                           STD DEV:     61.359
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MODEL  JT8D U-R REPS 649185  SAMPLE NUMBER =    3.


 MODE                 EMISSION     FUEL       TIME IN       CO          FUEL        LB CO /     ENERGY      LB CO /
                        RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN      47.204      771.609      19.00      14.948       244.34       61.114      266.00     0.05620
           STD DEV     8.046       40.094      0.0         2.548        12.70        9.556        0.0       0.00958

TAKEOFF     MEAN       9.046     8534.625      0.70        0.106        99.57        1.058      163.33     0.00065
           STD DEV     3.844       73.593      0.0         0.045         0.86        0.441        0.0       0.00027

CLIMBOUT    MEAN      13.821     7149.059      2.20        0.507       262.13        1.934      436.33     0.00116
           STD DEV     3.788       49.234      0.0         0.139         1.82        0.534        0.0       0.00032

APPROACH    MEAN      17.052     3466.591      4.00        1.137       231.11        4.918      373.33     0.00305
           STD DEV     0.531       42.615      0.0         0.035         2.85        0.100        0.0       0.00009

TAXI-IDLE   MEAN      47.204      771.609      7.00        5.507        90.02       61.114       98.00     0.05620
           STD DEV     8.046       40.094      0.0         0.939         4.68        9.556        0.06      0.00958

           TOTAL FOR CYCLE                      MEAN:     22.204       927.17                  1337.00
                                             STD DEV:      3.380        12.83                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     23.938
                                             STD DEV:      3.540

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     16.608
                                             STD DEV:      2.528

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.754
                                             STD DEV:      0.320


 MODE                 EMISSION     FUEL       TIME IN       HC          FUEL        LB HC /     ENERGY      LB HC /
                        RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       6.647      771.609      19.00       2.105       244.34        8.582      266.00     0.00791
           STD DEV     1.092       40.094      0.0         0.346        12.70        0.942        0.0       0.00130

TAKEOFF     MEAN       0.117     8534.625      0.70        0.001        99.57        0.014      163.33     0.00001
           STD DEV     0.102       73.593      0.0         0.001         0.86        0.012        0.0       0.00001

CLIMBOUT    MEAN       0.067     7149.059      2.20        0.002       262.13        0.009      436.33     0.00001
           STD DEV     0.071       49.234      0.0         0.003         1.82        0.010        0.0       0.00001

APPROACH    MEAN       0.505     3466.591      4.00        0.034       231.11        0.145      373.33     0.00009
           STD DEV     0.302       42.615      0.0         0.020         2.85        0.086        0.0       0.00005

TAXI-IDLE   MEAN       6.647      771.609      7.00        0.775        90.02        8.582       98.00     0.00791
           STD DEV     1.092       40.094      0.0         0.127         4.68        0.942        0.06      0.00130

           TOTAL FOR CYCLE                      MEAN:      2.918       927.17                  1337.00
                                             STD DEV:      0.460        12.83                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:      3.143
                                             STD DEV:      0.450

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:      2.182
                                             STD DEV:      0.344

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.098
                                             STD DEV:      0.085


 MODE                 EMISSION     FUEL       TIME IN       NOX         FUEL        LB NOX/     ENERGY      LB NOX/
                        RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       1.989      771.609      19.00       0.630       244.34        2.582      266.00     0.00237
           STD DEV     0.072       40.094      0.0         0.023        12.70        0.142        0.0       0.00009

TAKEOFF     MEAN      92.425     8534.625      0.70        1.078        99.57       10.830      163.33     0.00660
           STD DEV     2.063       73.593      0.0         0.024         0.86        0.244        0.0       0.00015

CLIMBOUT    MEAN      60.983     7149.059      2.20        2.236       262.13        8.530      436.33     0.00512
           STD DEV     0.672       49.234      0.0         0.025         1.82        0.071        0.0       0.00006

APPROACH    MEAN      16.601     3466.591      4.00        1.107       231.11        4.787      373.33     0.00296
           STD DEV     0.803       42.615      0.0         0.053         2.85        0.174        0.0       0.00014

TAXI-IDLE   MEAN       1.989      771.609      7.00        0.232        90.02        2.582       98.00     0.00237
           STD DEV     0.072       40.094      0.0         0.008         4.68        0.142        0.06      0.00009

           TOTAL FOR CYCLE                      MEAN:      5.283       927.17                  1337.00
                                             STD DEV:      0.096        12.83                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:      5.700
                                             STD DEV:      0.177

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:      3.951
                                             STD DEV:      0.072

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   77.021
                                             STD DEV:      1.700
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APPENDIX IV

STATISTICAL SUMMARIES OF HOMOGENEOUS CATEGORIES OF AIRCRAFT ENGINES

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IV-2	T56-A7 ENGINES, TESTED BY SWRI
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MODEL  T56-A7  SWRI          SAMPLE NUMBER =  11.


 MODE                  EMISSION      FUEL        TIME IN       CO          FUEL        LB CO /       ENERGY       LB CO /
                         RATE        RATE         MODE        MASS         MASS      1K LB FUEL      HP-HR        HP-HR
                        LB/HR       LB/HR         MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       15.268      548.004       19.00       4.835       173.53        28.101        35.67      0.13553
           STD DEV      3.519       54.095        0.0        1.115        17.13         6.597         0.04      0.03124

TAKEOFF     MEAN        2.150     2079.317        0.70       0.025        24.26         1.040        43.81      0.00057
           STD DEV      1.285       77.480        0.0        0.015         0.90         0.627         0.10      0.00034

CLIMBOUT    MEAN        3.009     1908.447        2.20       0.110        69.98         1.579       123.91      0.00089
           STD DEV      0.791       25.675        0.0        0.029         0.95         0.421         0.08      0.00023

APPROACH    MEAN        3.668     1052.900        4.00       0.245        70.19         3.482        75.10      0.00326
           STD DEV      0.841       23.937        0.0        0.056         1.60         0.787         0.08      0.00075

TAXI-IDLE   MEAN       15.268      548.004        7.00       1.781        63.93        28.101        13.14      0.13553
           STD DEV      3.519       54.095        0.0        0.411         6.31         6.597         0.01      0.03124

           TOTAL FOR CYCLE                      MEAN:    6.996       401.90                     291.64
                                             STD DEV:    1.502        24.21                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:   17.455
                                             STD DEV:    3.674

           LBS POLLUTANT/1K HP-HR/CYCLE         MEAN:   23.989
                                             STD DEV:    5.152

           LBS POLLUTANT/1000K HP-HR AT T.O.    MEAN:    0.668
                                             STD DEV:    0.399


 MODE                  EMISSION      FUEL        TIME IN       HC          FUEL        LB HC /       ENERGY       LB HC /
                         RATE        RATE         MODE        MASS         MASS      1K LB FUEL      HP-HR        HP-HR
                        LB/HR       LB/HR         MIN.        LBS.         LBS.

TAXI-IDLE   MEAN        6.474      548.004       19.00       2.050       173.53        11.923        35.67      0.05747
           STD DEV      1.612       54.095        0.0        0.511        17.13         3.054         0.04      0.01431

TAKEOFF     MEAN        0.430     2079.317        0.70       0.005        24.26         0.207        43.81      0.00011
           STD DEV      0.911       77.480        0.0        0.011         0.90         0.438         0.10      0.00024

CLIMBOUT    MEAN        0.476     1908.447        2.20       0.017        69.98         0.250       123.91      0.00014
           STD DEV      0.976       25.675        0.0        0.036         0.95         0.512         0.08      0.00029

APPROACH    MEAN        0.517     1052.900        4.00       0.034        70.19         0.491        75.10      0.00046
           STD DEV      1.004       23.937        0.0        0.067         1.60         0.952         0.08      0.00089

TAXI-IDLE   MEAN        6.474      548.004        7.00       0.755        63.93        11.923        13.14      0.05747
           STD DEV      1.612       54.095        0.0        0.188         6.31         3.054         0.01      0.01431

           TOTAL FOR CYCLE                      MEAN:    2.863       401.90                     291.64
                                             STD DEV:    0.704        24.21                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    7.155
                                             STD DEV:    1.790

           LBS POLLUTANT/1K HP-HR/CYCLE         MEAN:    9.815
                                             STD DEV:    2.414

           LBS POLLUTANT/1000K HP-HR AT T.O.    MEAN:    1.337
                                             STD DEV:    2.830


 MODE                  EMISSION      FUEL        TIME IN      NOX          FUEL        LB NOX/       ENERGY       LB NOX/
                         RATE        RATE         MODE        MASS         MASS      1K LB FUEL      HP-HR        HP-HR
                        LB/HR       LB/HR         MIN.        LBS.         LBS.

TAXI-IDLE   MEAN        2.161      548.004       19.00       0.684       173.53         3.932        35.67      0.01918
           STD DEV      0.499       54.095        0.0        0.158        17.13         0.743         0.04      0.00443

TAKEOFF     MEAN       22.878     2079.317        0.70       0.267        24.26        10.984        43.81      0.00609
           STD DEV      3.566       77.480        0.0        0.042         0.90         1.501         0.10      0.00095

CLIMBOUT    MEAN       21.212     1908.447        2.20       0.778        69.98        11.111       123.91      0.00629
           STD DEV      2.314       25.675        0.0        0.085         0.95         1.154         0.08      0.00068

APPROACH    MEAN        7.776     1052.900        4.00       0.518        70.19         7.382        75.10      0.00690
           STD DEV      0.913       23.937        0.0        0.061         1.60         0.812         0.08      0.00081

TAXI-IDLE   MEAN        2.161      548.004        7.00       0.252        63.93         3.932        13.14      0.01918
           STD DEV      0.499       54.095        0.0        0.058         6.31         0.743         0.01      0.00443

           TOTAL FOR CYCLE                      MEAN:    2.499       401.90                     291.64
                                             STD DEV:    0.371        24.21                       0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    6.212
                                             STD DEV:    0.765

           LBS POLLUTANT/1K HP-HR/CYCLE         MEAN:    8.570
                                             STD DEV:    1.271

           LBS POLLUTANT/1000K HP-HR AT T.O.    MEAN:   71.082
                                             STD DEV:   11.080
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MODEL  T56-A15  ALLISON      SAMPLE NUMBER =  11.


MODE                 EMISSION     FUEL       TIME IN      CO          FUEL       LB CO /     ENERGY      LB CO /
                       RATE       RATE        MODE       MASS         MASS      1K LB FUEL    HP-HR       HP-HR
                      LB/HR      LB/HR        MIN.       LBS.         LBS.

TAXI-IDLE   MEAN      6.779     485.527      19.00      2.147       153.75       14.909       43.61     0.04922
            STD DEV   3.348     125.216       0.0       1.060        39.65        8.335        0.09     0.02431

TAKEOFF     MEAN      3.916    2395.748       0.70      0.046        27.95        1.626       53.56     0.00085
            STD DEV   1.241     130.378       0.0       0.014         1.52        0.465        0.09     0.00027

CLIMBOUT    MEAN      3.500    2190.641       2.20      0.128        80.32        1.592      151.50     0.00085
            STD DEV   0.764      99.591       0.0       0.028         3.65        0.295        0.08     0.00018

APPROACH    MEAN      3.520    1146.848       4.00      0.235        76.46        3.069       91.82     0.00256
            STD DEV   0.883      20.452       0.0       0.059         1.36        0.761        0.08     0.00064

TAXI-IDLE   MEAN      6.779     485.527       7.00      0.791        56.64       14.909       16.07     0.04922
            STD DEV   3.348     125.216       0.0       0.391        14.61        8.335        0.0      0.02431

          TOTAL FOR CYCLE                    MEAN:      3.346       395.13                   356.57
                                         STD DEV:      1.506        56.15                     0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:      8.573
                                         STD DEV:      3.866

          LBS POLLUTANT/1K HP-HR/CYCLE        MEAN:      9.384
                                         STD DEV:      4.224

          LBS POLLUTANT/1000K HP-HR AT T.O.   MEAN:      0.995
                                         STD DEV:      0.315


MODE                 EMISSION     FUEL       TIME IN      HC          FUEL       LB HC /     ENERGY      LB HC /
                       RATE       RATE        MODE       MASS         MASS      1K LB FUEL    HP-HR       HP-HR
                      LB/HR      LB/HR        MIN.       LBS.         LBS.

TAXI-IDLE   MEAN      6.377     485.527      19.00      2.019       153.75       13.489       43.61     0.04630
            STD DEV   4.226     125.216       0.0       1.338        39.65        7.858        0.09     0.03068

TAKEOFF     MEAN      0.429    2395.748       0.70      0.005        27.95        0.173       53.56     0.00009
            STD DEV   0.698     130.378       0.0       0.008         1.52        0.285        0.09     0.00015

CLIMBOUT    MEAN      0.389    2190.641       2.20      0.014        80.32        0.174      151.50     0.00009
            STD DEV   0.618      99.591       0.0       0.023         3.65        0.279        0.08     0.00015

APPROACH    MEAN      0.306    1146.848       4.00      0.020        76.46        0.268       91.82     0.00022
            STD DEV   0.329      20.452       0.0       0.022         1.36        0.287        0.08     0.00024

TAXI-IDLE   MEAN      6.377     485.527       7.00      0.744        56.64       13.489       16.07     0.04630
            STD DEV   4.226     125.216       0.0       0.493        14.61        7.856        0.0      0.03068

          TOTAL FOR CYCLE                    MEAN:      2.803       395.13                   356.57
                                         STD DEV:      1.815        56.15                     0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:      7.066
                                         STD DEV:      4.221

          LBS POLLUTANT/1K HP-HR/CYCLE        MEAN:      7.861
                                         STD DEV:      5.090

          LBS POLLUTANT/1000K HP-HR AT T.O.   MEAN:      1.090
                                         STD DEV:      1.773


MODE                 EMISSION     FUEL       TIME IN      NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                       RATE       RATE        MODE       MASS         MASS      1K LB FUEL    HP-HR       HP-HR
                      LB/HR      LB/HR        MIN.       LBS.         LBS.

TAXI-IDLE   MEAN      1.194     485.527      19.00      0.378       153.75        2.406       43.61     0.00867
            STD DEV   0.717     125.216       0.0       0.227        39.65        1.230        0.09     0.00521

TAKEOFF     MEAN     28.495    2395.748       0.70      0.332        27.95       11.892       53.56     0.00621
            STD DEV  11.898     130.378       0.0       0.139         1.52        4.927        0.09     0.00259

CLIMBOUT    MEAN     22.441    2190.641       2.20      0.823        80.32       10.242      151.50     0.00543
            STD DEV   3.600      99.591       0.0       0.132         3.65        1.584        0.08     0.00087

APPROACH    MEAN      7.225    1146.848       4.00      0.482        76.46        6.292       91.82     0.00525
            STD DEV   1.608      20.452       0.0       0.107         1.36        1.348        0.08     0.00117

TAXI-IDLE   MEAN      1.194     485.527       7.00      0.139        56.64        2.406       16.07     0.00867
            STD DEV   0.717     125.216       0.0       0.084        14.61        1.230        0.0      0.00521

          TOTAL FOR CYCLE                    MEAN:      2.155       395.13                   356.57
                                         STD DEV:      0.579        56.15                     0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:      5.420
                                         STD DEV:      1.086

          LBS POLLUTANT/1K HP-HR/CYCLE        MEAN:      6.042
                                         STD DEV:      1.624

          LBS POLLUTANT/1000K HP-HR AT T.O.   MEAN:     72.413
                                         STD DEV:     30.236
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MODEL  TPE 331 AIRESEARCH    SAMPLE NUMBER =   3.


 MODE                 EMISSION      FUEL      TIME IN       CO         FUEL      LB CO /     ENERGY      LB CO /
                        RATE        RATE       MODE        MASS        MASS     1K LB FUEL    HP-HR        HP-HR
                        LB/HR       LB/HR      MIN.        LBS.        LBS.

TAXI-IDLE   MEAN       3.533      145.910     19.00       1.119       46.20      24.351      11.11      0.10086
            STD DEV    0.640       16.530      0.0        0.203        5.23       4.413       0.16      0.01989

TAKEOFF     MEAN       0.393      365.419      0.70       0.005        4.26       1.082       6.82      0.00067
            STD DEV    0.309        9.366      0.0        0.004        0.11       0.848       0.10      0.00052

CLIMBOUT    MEAN       0.568      339.093      2.20       0.021       12.43       1.684      19.30      0.00107
            STD DEV    0.313       10.361      0.0        0.011        0.38       0.936       0.29      0.00058

APPROACH    MEAN       2.582      206.096      4.00       0.172       13.74      12.537      11.70      0.01469
            STD DEV    0.443        7.348      0.0        0.030        0.49       2.145       0.17      0.00235

TAXI-IDLE   MEAN       3.533      145.910      7.00       0.412       17.02      24.351       4.09      0.10086
            STD DEV    0.640       16.530      0.0        0.075        1.93       4.413       0.06      0.01989

         TOTAL FOR CYCLE                         MEAN:    1.729       93.66                  53.04
                                              STD DEV:    0.238        8.01                   0.78

         LBS POLLUTANT/1K LB FUEL/CYCLE          MEAN:   18.495
                                              STD DEV:    2.390

         LBS POLLUTANT/1K HP-HR/CYCLE            MEAN:   32.640
                                              STD DEV:    5.018

         LBS POLLUTANT/1000K HP-HR AT T.O.       MEAN:    0.778
                                              STD DEV:    0.610


 MODE                 EMISSION      FUEL      TIME IN       HC         FUEL      LB HC /     ENERGY      LB HC /
                        RATE        RATE       MODE        MASS        MASS     1K LB FUEL    HP-HR        HP-HR
                        LB/HR       LB/HR      MIN.        LBS.        LBS.

TAXI-IDLE   MEAN       0.879      145.910     19.00       0.278       46.20       6.091      11.11      0.02520
            STD DEV    0.579       16.530      0.0        0.183        5.23       3.835       0.16      0.01695

TAKEOFF     MEAN       0.055      365.419      0.70       0.001        4.26       0.153       6.82      0.00009
            STD DEV    0.062        9.366      0.0        0.001        0.11       0.175       0.10      0.00011

CLIMBOUT    MEAN       0.053      339.093      2.20       0.002       12.43       0.158      19.30      0.00010
            STD DEV    0.060       10.361      0.0        0.002        0.38       0.184       0.29      0.00011

APPROACH    MEAN       0.240      206.096      4.00       0.016       13.74       1.177      11.70      0.00136
            STD DEV    0.125        7.348      0.0        0.008        0.49       0.643       0.17      0.00070

TAXI-IDLE   MEAN       0.879      145.910      7.00       0.103       17.02       6.091       4.09      0.02520
            STD DEV    0.579       16.530      0.0        0.067        1.93       3.835       0.06      0.01695

         TOTAL FOR CYCLE                         MEAN:    0.400       93.66                  53.04
                                              STD DEV:    0.245        8.01                   0.78

         LBS POLLUTANT/1K LB FUEL/CYCLE          MEAN:    4.292
                                              STD DEV:    2.538

         LBS POLLUTANT/1K HP-HR/CYCLE            MEAN:    7.576
                                              STD DEV:    4.755

         LBS POLLUTANT/1000K HP-HR AT T.O.       MEAN:    1.096
                                              STD DEV:    1.227


 MODE                 EMISSION      FUEL      TIME IN       NOX        FUEL      LB NOX/     ENERGY      LB NOX/
                        RATE        RATE       MODE        MASS        MASS     1K LB FUEL    HP-HR        HP-HR
                        LB/HR       LB/HR      MIN.        LBS.        LBS.

TAXI-IDLE   MEAN       0.955      145.910     19.00       0.302       46.20       6.417      11.11      0.02719
            STD DEV    0.360       16.530      0.0        0.114        5.23       1.795       0.16      0.01016

TAKEOFF     MEAN       3.639      365.419      0.70       0.042        4.26       9.902       6.82      0.00624
            STD DEV    1.276        9.366      0.0        0.015        0.11       3.263       0.10      0.00226

CLIMBOUT    MEAN       3.313      339.093      2.20       0.121       12.43       9.706      19.30      0.00631
            STD DEV    1.191       10.361      0.0        0.044        0.38       3.245       0.29      0.00234

APPROACH    MEAN       1.695      206.096      4.00       0.112       13.74       8.113      11.70      0.00962
            STD DEV    0.593        7.348      0.0        0.040        0.49       2.641       0.17      0.00347

TAXI-IDLE   MEAN       0.955      145.910      7.00       0.111       17.02       6.417       4.09      0.02719
            STD DEV    0.360       16.530      0.0        0.042        1.93       1.795       0.06      0.01016

         TOTAL FOR CYCLE                         MEAN:    0.690       93.66                  53.04
                                              STD DEV:    0.233        8.01                   0.78

         LBS POLLUTANT/1K LB FUEL/CYCLE          MEAN:    7.255
                                              STD DEV:    1.944

         LBS POLLUTANT/1K HP-HR/CYCLE            MEAN:   13.020
                                              STD DEV:    4.418

         LBS POLLUTANT/1000K HP-HR AT T.O.       MEAN:   72.765
                                              STD DEV:   26.312
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MODEL  CJ-805-3A  SWRI       SAMPLE NUMBER =   8.


MODE                 EMISSION     FUEL       TIME IN      CO         FUEL      LB CO /     ENERGY      LB CO /
                       RATE       RATE        MODE       MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.       LBS.        LBS.


TAXI-IDLE   MEAN      63.767    1000.692      19.00     20.193      316.89      63.286      141.87     0.14234
            STD DEV   13.744     128.982      0.0        4.352       40.84       7.654        0.19     0.03068

TAKEOFF     MEAN      29.071    9959.773       0.70      0.339      116.20       2.921      130.67     0.00260
            STD DEV    4.213     251.241      0.0        0.049        2.93       0.437        0.13     0.00038

CLIMBOUT    MEAN      28.876    8290.375       2.20      1.059      303.98       3.488      349.07     0.00303
            STD DEV    4.592     181.826      0.0        0.168        6.67       0.584        0.0      0.00048

APPROACH    MEAN      42.825    3776.597       4.00      2.855      251.77      11.509      298.67     0.00956
            STD DEV   14.524     314.310      0.0        0.968       20.95       4.613        0.0      0.00324

TAXI-IDLE   MEAN      63.767    1000.692       7.00      7.440      116.75      63.286       52.27     0.14234
            STD DEV   13.744     128.982      0.0        1.603       15.05       7.654        0.06     0.03068

         TOTAL FOR CYCLE                        MEAN:   31.885     1105.58                  972.53
                                            STD DEV:    6.547       62.21                    1.20

         LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:   28.662
                                            STD DEV:    4.585

         LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   32.786
                                            STD DEV:    6.732

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    3.028
                                            STD DEV:    0.439


MODE                 EMISSION     FUEL       TIME IN      HC         FUEL      LB HC /     ENERGY      LB HC /
                       RATE       RATE        MODE       MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.       LBS.        LBS.


TAXI-IDLE   MEAN      27.309    1000.692      19.00      8.648      316.89      27.147      141.87     0.06096
            STD DEV    7.638     128.982      0.0        2.419       40.84       5.843        0.19     0.01705

TAKEOFF     MEAN       0.556    9959.773       0.70      0.006      116.20       0.056      130.67     0.00005
            STD DEV    0.547     251.241      0.0        0.006        2.93       0.054        0.13     0.00005

CLIMBOUT    MEAN       0.583    8290.375       2.20      0.021      303.98       0.070      349.07     0.00006
            STD DEV    0.442     181.826      0.0        0.016        6.67       0.053        0.0      0.00005

APPROACH    MEAN       2.427    3776.597       4.00      0.162      251.77       0.645      298.67     0.00054
            STD DEV    1.882     314.310      0.0        0.125       20.95       0.493        0.0      0.00042

TAXI-IDLE   MEAN      27.309    1000.692       7.00      3.186      116.75      27.147       52.27     0.06096
            STD DEV    7.638     128.982      0.0        0.891       15.05       5.843        0.06     0.01705

         TOTAL FOR CYCLE                        MEAN:   12.024     1105.58                  972.53
                                            STD DEV:    3.297       62.21                    1.20

         LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:   10.849
                                            STD DEV:    2.798

         LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:   12.363
                                            STD DEV:    3.390

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.579
                                            STD DEV:    0.570


MODE                 EMISSION     FUEL       TIME IN      NOX        FUEL      LB NOX/     ENERGY      LB NOX/
                       RATE       RATE        MODE       MASS        MASS     1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.       LBS.        LBS.


TAXI-IDLE   MEAN       1.566    1000.692      19.00      0.496      316.89       1.547      141.87     0.00350
            STD DEV    0.450     128.982      0.0        0.143       40.84       0.323        0.19     0.00101

TAKEOFF     MEAN     110.632    9959.773       0.70      1.291      116.20      11.086      130.67     0.00988
            STD DEV   17.743     251.241      0.0        0.207        2.93       1.565        0.13     0.00158

CLIMBOUT    MEAN      73.982    8290.375       2.20      2.713      303.98       8.917      349.07     0.00777
            STD DEV    6.116     181.826      0.0        0.224        6.67       0.600        0.0      0.00064

APPROACH    MEAN      17.845    3776.597       4.00      1.190      251.77       4.739      298.67     0.00398
            STD DEV    1.362     314.310      0.0        0.091       20.95       0.336        0.0      0.00030

TAXI-IDLE   MEAN       1.566    1000.692       7.00      0.183      116.75       1.547       52.27     0.00350
            STD DEV    0.450     128.982      0.0        0.053       15.05       0.323        0.06     0.00101

         TOTAL FOR CYCLE                        MEAN:    5.872     1105.58                  972.53
                                            STD DEV:    0.466       62.21                    1.20

         LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:    5.315
                                            STD DEV:    0.376

         LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:    6.037
                                            STD DEV:    0.479

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  115.242
                                            STD DEV:   18.482
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MODEL  JT3C UNITED           SAMPLE NUMBER =   4.


 MODE                  EMISSION     FUEL       TIME IN       CO          FUEL        LB CO /     ENERGY      LB CO /
                         RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                        LB/HR      LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN      115.427    1227.736      19.00      36.552       388.78       93.677      190.00     0.19238
            STD DEV    19.037      84.711       0.0        6.028        26.83       11.397        0.14     0.03173

TAKEOFF     MEAN       10.659   10218.871       0.70       0.124       119.22        1.043      140.00     0.00089
            STD DEV     7.444     165.763       0.0        0.087         1.95        0.725        0.25     0.00062

CLIMBOUT    MEAN       20.926    8553.961       2.20       0.767       313.65        2.447      374.00     0.00205
            STD DEV     3.013      96.443       0.0        0.110         3.54        0.361        0.0      0.00030

APPROACH    MEAN       67.123    3970.854       4.00       4.475       264.72       16.971      320.00     0.01398
            STD DEV     9.214     147.404       0.0        0.614         9.83        2.772        0.0      0.00192

TAXI-IDLE   MEAN      115.427    1227.736       7.00      13.466       143.24       93.677       70.00     0.19238
            STD DEV    19.037      84.711       0.0        2.221         9.88       11.397        0.09     0.03173

          TOTAL FOR CYCLE                      MEAN:  55.385      1229.61                   1094.00
                                           STD DEV:   8.455        44.41                      0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:  44.949
                                           STD DEV:   5.944

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:  50.626
                                           STD DEV:   7.729

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:  1.036
                                           STD DEV:   0.724


 MODE                  EMISSION     FUEL       TIME IN       HC          FUEL        LB HC /     ENERGY      LB HC /
                         RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                        LB/HR      LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN       88.741    1227.736      19.00      28.101       388.78       72.935      190.00     0.14790
            STD DEV    43.398      84.711       0.0       13.743        26.83       35.557        0.14     0.07233

TAKEOFF     MEAN        0.090   10218.871       0.70       0.001       119.22        0.009      140.00     0.00001
            STD DEV     0.181     165.763       0.0        0.002         1.95        0.018        0.25     0.00002

CLIMBOUT    MEAN        0.634    8553.961       2.20       0.023       313.65        0.074      374.00     0.00006
            STD DEV     0.584      96.443       0.0        0.021         3.54        0.068        0.0      0.00006

APPROACH    MEAN       11.296    3970.854       4.00       0.753       264.72        2.805      320.00     0.00235
            STD DEV     7.539     147.404       0.0        0.503         9.83        1.779        0.0      0.00157

TAXI-IDLE   MEAN       88.741    1227.736       7.00      10.353       143.24       72.935       70.00     0.14790
            STD DEV    43.398      84.711       0.0        5.063         9.88       35.557        0.09     0.07233

          TOTAL FOR CYCLE                      MEAN:  39.232      1229.61                   1094.00
                                           STD DEV:  19.251        44.41                      0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:  31.914
                                           STD DEV:  15.447

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:  35.861
                                           STD DEV:  17.597

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:  0.088
                                           STD DEV:   0.176


 MODE                  EMISSION     FUEL       TIME IN       NOX         FUEL        LB NOX/     ENERGY      LB NOX/
                         RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                        LB/HR      LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN        3.068    1227.736      19.00       0.972       388.78        2.496      190.00     0.00511
            STD DEV     0.439      84.711       0.0        0.139        26.83        0.276        0.14     0.00073

TAKEOFF     MEAN      128.081   10218.871       0.70       1.494       119.22       12.512      140.00     0.01067
            STD DEV    23.809     165.763       0.0        0.278         1.95        2.152        0.25     0.00198

CLIMBOUT    MEAN       89.497    8553.961       2.20       3.282       313.65       10.450      374.00     0.00877
            STD DEV    14.732      96.443       0.0        0.540         3.54        1.618        0.0      0.00144

APPROACH    MEAN       23.157    3970.854       4.00       1.544       264.72        5.830      320.00     0.00482
            STD DEV     3.772     147.404       0.0        0.251         9.83        0.928        0.0      0.00079

TAXI-IDLE   MEAN        3.068    1227.736       7.00       0.358       143.24        2.496       70.00     0.00511
            STD DEV     0.439      84.711       0.0        0.051         9.88        0.276        0.09     0.00073

          TOTAL FOR CYCLE                      MEAN:   7.649      1229.61                   1094.00
                                           STD DEV:   0.886        44.41                      0.0

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:   6.231
                                           STD DEV:   0.806

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:   6.992
                                           STD DEV:   0.810

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN: 124.523
                                           STD DEV:  23.147
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MODEL  JT3C SWRI             SAMPLE NUMBER =   3.


MODE                  EMISSION      FUEL      TIME IN       CO          FUEL       LB CO /      ENERGY      LB CO /
                        RATE        RATE       MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.


TAXI-IDLE   MEAN      62.225    1157.855     19.00      19.705       366.65       55.455       184.72     0.10792
            STD DEV   38.042      93.979     0.0        12.046        29.76       35.576         9.14     0.06723

TAKEOFF     MEAN       6.873   10135.688      0.70       0.080       118.25        0.660       136.11     0.00058
            STD DEV    9.572     681.645     0.0         0.112         7.95        0.896         6.74     0.00079

CLIMBOUT    MEAN       9.332    8449.488      2.20       0.342       309.81        1.108       363.61     0.00094
            STD DEV    9.182     573.425     0.0         0.337        21.03        1.049        17.99     0.00090

APPROACH    MEAN      24.871    4308.172      4.00       1.658       287.21        5.837       311.11     0.00538
            STD DEV    6.388     224.606     0.0         0.426        14.97        1.834        15.40     0.00168

TAXI-IDLE   MEAN      62.225    1157.855      7.00       7.260       135.08       55.455        68.06     0.10792
            STD DEV   38.042      93.979     0.0         4.438        10.97       35.576         3.37     0.06723

          TOTAL FOR CYCLE                      MEAN:   29.044      1217.01                   1063.61
                                           STD DEV:   16.993        54.43                     52.63

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:   24.282
                                           STD DEV:   14.640

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:   27.620
                                           STD DEV:   16.524

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    0.676
                                           STD DEV:    0.925


MODE                  EMISSION      FUEL      TIME IN       HC          FUEL       LB HC /      ENERGY      LB HC /
                        RATE        RATE       MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.


TAXI-IDLE   MEAN      96.789    1157.855     19.00      30.650       366.65       85.931       184.72     0.16980
            STD DEV   78.557      93.979     0.0        24.876        29.76       68.789         9.14     0.14275

TAKEOFF     MEAN       1.874   10135.688      0.70       0.022       118.25        0.188       136.11     0.00016
            STD DEV    1.631     681.645     0.0         0.019         7.95        0.163         6.74     0.00014

CLIMBOUT    MEAN       1.239    8449.488      2.20       0.045       309.81        0.148       363.61     0.00013
            STD DEV    0.499     573.425     0.0         0.018        21.03        0.060        17.99     0.00005

APPROACH    MEAN       4.215    4308.172      4.00       0.281       287.21        0.969       311.11     0.00089
            STD DEV    2.428     224.606     0.0         0.162        14.97        0.539        15.40     0.00049

TAXI-IDLE   MEAN      96.789    1157.855      7.00      11.292       135.08       85.931        68.06     0.16980
            STD DEV   78.557      93.979     0.0         9.165        10.97       68.789         3.37     0.14275

          TOTAL FOR CYCLE                      MEAN:   42.290      1217.01                   1063.61
                                           STD DEV:   33.889        54.43                     52.63

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:   35.614
                                           STD DEV:   29.102

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:   40.679
                                           STD DEV:   33.797

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    1.900
                                           STD DEV:    1.646


MODE                  EMISSION      FUEL      TIME IN       NOX         FUEL       LB NOX/      ENERGY      LB NOX/
                        RATE        RATE       MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.        LBS.         LBS.


TAXI-IDLE   MEAN       1.716    1157.855     19.00       0.543       366.65        1.489       184.72     0.00295
            STD DEV    0.036      93.979     0.0         0.012        29.76        0.138         9.14     0.00021

TAKEOFF     MEAN     106.911   10135.688      0.70       1.247       118.25       10.470       136.11     0.00911
            STD DEV   27.579     681.645     0.0         0.322         7.95        2.130         6.74     0.00202

CLIMBOUT    MEAN      78.245    8449.488      2.20       2.869       309.81        9.235       363.61     0.00787
            STD DEV   11.146     573.425     0.0         0.409        21.03        0.818        17.99     0.00081

APPROACH    MEAN      23.285    4308.172      4.00       1.552       287.21        5.419       311.11     0.00500
            STD DEV    0.696     224.606     0.0         0.046        14.97        0.428        15.40     0.00039

TAXI-IDLE   MEAN       1.716    1157.855      7.00       0.200       135.08        1.489        68.06     0.00295
            STD DEV    0.036      93.979     0.0         0.004        10.97        0.138         3.37     0.00021

          TOTAL FOR CYCLE                      MEAN:    6.412      1217.01                   1063.61
                                           STD DEV:    0.705        54.43                     52.63

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    5.272
                                           STD DEV:    0.583

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:    6.021
                                           STD DEV:    0.454

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:  106.320
                                           STD DEV:   23.546
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MODEL  JT3D P&W              SAMPLE NUMBER =   5.

 MODE                EMISSION      FUEL      TIME IN      CO        FUEL       LB CO /     ENERGY     LB CO /
                       RATE        RATE       MODE       MASS       MASS     1K LB FUEL   # TH-HR    # TH-HR
                       LB/HR       LB/HR      MIN.       LBS.       LBS.

TAXI-IDLE   MEAN      81.990      779.227     19.00     25.963     246.76     105.740      285.00    0.09110
           STD DEV    36.606      334.953     0.0       11.592     106.07       8.632        0.0     0.04067

TAKEOFF     MEAN       7.695    10121.176      0.70      0.090     118.08       0.775      210.00    0.00043
           STD DEV     7.338      291.204     0.0        0.086       3.40       0.739        0.18    0.00041

CLIMBOUT    MEAN      12.017     8238.910      2.20      0.441     302.09       1.487      561.00    0.00079
           STD DEV     5.787      451.628     0.0        0.212      16.56       0.764        0.0     0.00038

APPROACH    MEAN      37.023     3660.162      4.00      2.468     244.01      10.097      480.00    0.00514
           STD DEV     5.566      196.092     0.0        0.371      13.07       1.241        0.0     0.00077

TAXI-IDLE   MEAN      81.990      779.227      7.00      9.565      90.91     105.740      105.00    0.09110
           STD DEV    36.606      334.953     0.0        4.271      39.08       8.632        0.15    0.04067

           TOTAL FOR CYCLE                    MEAN:     38.527    1001.85                  1641.00
                                          STD DEV:     15.797     169.97                     1.94

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:    36.936
                                          STD DEV:     11.462

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:    23.478
                                          STD DEV:      9.627

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.499
                                          STD DEV:      0.476


 MODE                EMISSION      FUEL      TIME IN      HC        FUEL       LB HC /     ENERGY     LB HC /
                       RATE        RATE       MODE       MASS       MASS     1K LB FUEL   # TH-HR    # TH-HR
                       LB/HR       LB/HR      MIN.       LBS.       LBS.

TAXI-IDLE   MEAN      44.885      779.227     19.00     14.214     246.76      66.391      285.00    0.04987
           STD DEV    28.600      334.953     0.0        9.057     106.07      37.017        0.0     0.03178

TAKEOFF     MEAN       1.982    10121.176      0.70      0.023     118.08       0.199      210.00    0.00011
           STD DEV     1.803      291.204     0.0        0.021       3.40       0.182        0.18    0.00010

CLIMBOUT    MEAN       2.139     8238.910      2.20      0.078     302.09       0.269      561.00    0.00014
           STD DEV     1.624      451.628     0.0        0.060      16.56       0.207        0.0     0.00011

APPROACH    MEAN       4.817     3660.162      4.00      0.321     244.01       1.330      480.00    0.00067
           STD DEV     2.271      196.092     0.0        0.151      13.07       0.652        0.0     0.00032

TAXI-IDLE   MEAN      44.885      779.227      7.00      5.237      90.91      66.391      105.00    0.04987
           STD DEV    28.600      334.953     0.0        3.337      39.08      37.017        0.15    0.03178

           TOTAL FOR CYCLE                    MEAN:     19.873    1001.85                  1641.00
                                          STD DEV:     12.519     169.97                     1.94

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:    19.791
                                          STD DEV:     11.794

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:    12.110
                                          STD DEV:      7.629

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   1.285
                                          STD DEV:      1.169


 MODE                EMISSION      FUEL      TIME IN      NOX       FUEL       LB NOX/     ENERGY     LB NOX/
                       RATE        RATE       MODE       MASS       MASS     1K LB FUEL   # TH-HR    # TH-HR
                       LB/HR       LB/HR      MIN.       LBS.       LBS.

TAXI-IDLE   MEAN       1.331      779.227     19.00      0.422     246.76       1.862      285.00    0.00148
           STD DEV     0.662      334.953     0.0        0.210     106.07       0.700        0.0     0.00074

TAKEOFF     MEAN     141.347    10121.176      0.70      1.649     118.08      13.961      210.00    0.00785
           STD DEV    17.136      291.204     0.0        0.200       3.40       1.589        0.18    0.00095

CLIMBOUT    MEAN      89.484     8238.910      2.20      3.281     302.09      10.877      561.00    0.00585
           STD DEV     5.893      451.628     0.0        0.216      16.56       0.742        0.0     0.00039

APPROACH    MEAN      20.053     3660.162      4.00      1.337     244.01       5.495      480.00    0.00279
           STD DEV     0.894      196.092     0.0        0.060      13.07       0.454        0.0     0.00012

TAXI-IDLE   MEAN       1.331      779.227      7.00      0.155      90.91       1.862      105.00    0.00148
           STD DEV     0.662      334.953     0.0        0.077      39.08       0.700        0.15    0.00074

           TOTAL FOR CYCLE                    MEAN:      6.844    1001.85                  1641.00
                                          STD DEV:      0.590     169.97                     1.94

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:     6.970
                                          STD DEV:      1.129

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:     4.171
                                          STD DEV:      0.359

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  91.614
                                          STD DEV:     11.108
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MODEL  JT3D SWRI            SAMPLE NUMBER =   7.


MODE                 EMISSION       FUEL       TIME IN       CO         FUEL       LB CO /     ENERGY      LB CO /
                       RATE         RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR        LB/HR        MIN.        LBS.        LBS.


TAXI-IDLE   MEAN     102.886      853.590      19.00      32.581      270.30      114.834      285.00      0.11432
            STD DEV   86.372       81.384       0.0       27.351       25.77       82.394        0.0       0.09597

TAKEOFF     MEAN      10.101    11158.953       0.70       0.118      130.19        0.909      210.00      0.00056
            STD DEV    8.177      420.235       0.0        0.095        4.90        0.734        0.18      0.00045

CLIMBOUT    MEAN       9.962     9234.824       2.20       0.365      338.61        1.075      561.00      0.00065
            STD DEV    5.167      152.070       0.0        0.189        5.59        0.551        0.0       0.00034

APPROACH    MEAN      28.688     4242.242       4.00       1.913      282.82        6.780      480.00      0.00398
            STD DEV   11.554      170.341       0.0        0.770       11.35        2.784        0.0       0.00160

TAXI-IDLE   MEAN     102.886      853.590       7.00      12.003       99.59      114.834      105.00      0.11432
            STD DEV   86.372       81.384       0.0       10.077        9.49       82.394        0.10      0.09597

           TOTAL FOR CYCLE                       MEAN:   46.979     1121.50                  1641.00
                                             STD DEV:   36.861       48.63                     2.31

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:   41.083
                                             STD DEV:   30.279

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:   28.629
                                             STD DEV:   22.462

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.655
                                             STD DEV:    0.530


MODE                 EMISSION       FUEL       TIME IN       HC         FUEL       LB HC /     ENERGY      LB HC /
                       RATE         RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR        LB/HR        MIN.        LBS.        LBS.


TAXI-IDLE   MEAN      84.269      853.590      19.00      26.685      270.30       94.532      285.00      0.09363
            STD DEV   61.350       81.384       0.0       19.428       25.77       57.934        0.0       0.06817

TAKEOFF     MEAN      11.810    11158.953       0.70       0.138      130.19        1.058      210.00      0.00066
            STD DEV   14.390      420.235       0.0        0.168        4.90        1.298        0.18      0.00080

CLIMBOUT    MEAN      12.776     9234.824       2.20       0.468      338.61        1.385      561.00      0.00084
            STD DEV   13.249      152.070       0.0        0.486        5.59        1.445        0.0       0.00087

APPROACH    MEAN      11.940     4242.242       4.00       0.796      282.82        2.787      480.00      0.00166
            STD DEV    8.939      170.341       0.0        0.596       11.35        2.084        0.0       0.00124

TAXI-IDLE   MEAN      84.269      853.590       7.00       9.831       99.59       94.532      105.00      0.09363
            STD DEV   61.350       81.384       0.0        7.158        9.49       57.934        0.10      0.06817

           TOTAL FOR CYCLE                       MEAN:   37.919     1121.50                  1641.00
                                             STD DEV:   27.333       48.63                     2.31

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:   33.201
                                             STD DEV:   22.473

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:   23.107
                                             STD DEV:   16.657

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    7.655
                                             STD DEV:    9.327


MODE                 EMISSION       FUEL       TIME IN      NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                       RATE         RATE        MODE        MASS        MASS      1K LB FUEL   # TH-HR     # TH-HR
                      LB/HR        LB/HR        MIN.        LBS.        LBS.


TAXI-IDLE   MEAN       1.144      853.590      19.00       0.362      270.30        1.335      285.00      0.00127
            STD DEV    0.236       81.384       0.0        0.075       25.77        0.223        0.0       0.00026

TAKEOFF     MEAN     147.570    11158.953       0.70       1.722      130.19       13.234      210.00      0.00820
            STD DEV   13.680      420.235       0.0        0.160        4.90        1.263        0.18      0.00076

CLIMBOUT    MEAN      94.513     9234.824       2.20       3.465      338.61       10.235      561.00      0.00618
            STD DEV    7.840      152.070       0.0        0.287        5.59        0.841        0.0       0.00051

APPROACH    MEAN      20.074     4242.242       4.00       1.338      282.82        4.726      480.00      0.00279
            STD DEV    1.828      170.341       0.0        0.122       11.35        0.276        0.0       0.00025

TAXI-IDLE   MEAN       1.144      853.590       7.00       0.133       99.59        1.335      105.00      0.00127
            STD DEV    0.236       81.384       0.0        0.028        9.49        0.223        0.10      0.00026

           TOTAL FOR CYCLE                       MEAN:    7.021     1121.50                  1641.00
                                             STD DEV:    0.534       48.63                     2.31

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:    6.263
                                             STD DEV:    0.441

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:    4.279
                                             STD DEV:    0.325

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   95.647
                                             STD DEV:    8.867
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MODEL  JT3D UNITED            SAMPLE NUMBER =   8.

MODE                  EMISSION     FUEL       TIME IN      CO        FUEL       LB CO /      ENERGY      LB CO /
                        RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN     145.859     932.654      19.00     46.189     295.34     162.571      288.96     0.16035
            STD DEV   48.057     178.731       0.0      15.218      56.60      60.231        7.33     0.05464
TAKEOFF     MEAN      16.851   10375.391       0.70      0.197     121.05       1.632      212.92     0.00093
            STD DEV    6.671     378.774       0.0       0.078       4.42       0.656        5.40     0.00036
CLIMBOUT    MEAN      24.867    8661.773       2.20      0.912     317.60       2.871      568.79     0.00161
            STD DEV    4.994     189.315       0.0       0.183       6.94       0.570       14.43     0.00035
APPROACH    MEAN      53.089    4120.699       4.00      3.539     274.71      12.800      486.67     0.00729
            STD DEV   30.501     216.834       0.0       2.033      14.45       7.319       12.33     0.00426
TAXI-IDLE   MEAN     145.859     932.654       7.00     17.017     108.81     162.571      106.46     0.16035
            STD DEV   48.057     178.731       0.0       5.607      20.85      60.231        2.71     0.05464
         TOTAL FOR CYCLE                      MEAN:     67.853    1117.51                 1663.79
                                          STD DEV:     20.378      91.07                   42.22

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     61.286
                                          STD DEV:     19.617

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     40.908
                                          STD DEV:     12.758

         LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      1.079
                                          STD DEV:      0.425


MODE                  EMISSION     FUEL       TIME IN      HC        FUEL       LB HC /      ENERGY      LB HC /
                        RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN     142.378     932.654      19.00     45.086     295.34     164.339      288.96     0.15678
            STD DEV   58.350     178.731       0.0      18.478      56.60      93.650        7.33     0.06613
TAKEOFF     MEAN       0.683   10375.391       0.70      0.008     121.05       0.062      212.92     0.00004
            STD DEV    1.933     378.774       0.0       0.023       4.42       0.176        5.40     0.00010
CLIMBOUT    MEAN       1.024    8661.773       2.20      0.038     317.60       0.116      568.79     0.00007
            STD DEV    1.481     189.315       0.0       0.054       6.94       0.167       14.43     0.00009
APPROACH    MEAN       4.946    4120.699       4.00      0.330     274.71       1.200      486.67     0.00068
            STD DEV    3.398     216.834       0.0       0.227      14.45       0.837       12.33     0.00048
TAXI-IDLE   MEAN     142.378     932.654       7.00     16.611     108.81     164.339      106.46     0.15678
            STD DEV   58.350     178.731       0.0       6.808      20.85      93.650        2.71     0.06613
         TOTAL FOR CYCLE                      MEAN:     62.072    1117.51                 1663.79
                                          STD DEV:     25.257      91.07                   42.22

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     56.717
                                          STD DEV:     26.122

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     37.486
                                          STD DEV:     15.702

         LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      0.420
                                          STD DEV:      1.187


MODE                  EMISSION     FUEL       TIME IN      NOX       FUEL       LB NOX/      ENERGY      LB NOX/
                        RATE       RATE        MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR        MIN.       LBS.       LBS.

TAXI-IDLE   MEAN       1.449     932.654      19.00      0.459     295.34       1.553      288.96     0.00159
            STD DEV    0.506     178.731       0.0       0.160      56.60       0.405        7.33     0.00056
TAKEOFF     MEAN     127.417   10375.391       0.70      1.487     121.05      12.265      212.92     0.00698
            STD DEV   12.514     378.774       0.0       0.146       4.42       0.913        5.40     0.00069
CLIMBOUT    MEAN      85.956    8661.773       2.20      3.152     317.60       9.923      568.79     0.00554
            STD DEV    5.442     189.315       0.0       0.199       6.94       0.566       14.43     0.00035
APPROACH    MEAN      20.651    4120.699       4.00      1.377     274.71       5.032      486.67     0.00283
            STD DEV    1.640     216.834       0.0       0.109      14.45       0.560       12.33     0.00025
TAXI-IDLE   MEAN       1.449     932.654       7.00      0.169     108.81       1.553      106.46     0.00159
            STD DEV    0.506     178.731       0.0       0.059      20.85       0.405        2.71     0.00056
         TOTAL FOR CYCLE                      MEAN:      6.643    1117.51                 1663.79
                                          STD DEV:      0.535      91.07                   42.22

         LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      5.967
                                          STD DEV:      0.530

         LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      3.995
                                          STD DEV:      0.335

         LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:     81.480
                                          STD DEV:      8.060
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MODEL  JT3D BUR. MINES        SAMPLE NUMBER =   2.


 MODE                 EMISSION     FUEL       TIME IN      CO          FUEL       LB CO /     ENERGY      LB CO /
                        RATE        RATE       MODE       MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.       LBS.         LBS.

TAXI-IDLE   MEAN      86.285     886.948      19.00      27.324       280.87      96.674      277.08     0.09818
            STD DEV   22.259      57.350      0.0         7.049        18.16      18.845       11.20     0.02147

TAKEOFF     MEAN       3.323   10462.508       0.70       0.039       122.06       0.322      204.17     0.00019
            STD DEV    1.082     682.911      0.0         0.013         7.97       0.124        8.25     0.00007

CLIMBOUT    MEAN      10.164    8650.008       2.20       0.373       317.17       1.171      545.42     0.00068
            STD DEV    1.759     520.461      0.0         0.065        19.08       0.133       22.04     0.00009

APPROACH    MEAN      40.480    4036.367       4.00       2.699       269.09       9.971      466.67     0.00576
            STD DEV    8.957     338.231      0.0         0.597        22.55       1.384       18.86     0.00105

TAXI-IDLE   MEAN      86.285     886.948       7.00      10.067       103.48      96.674      102.08     0.09818
            STD DEV   22.259      57.350      0.0         2.597         6.69      18.845        4.12     0.02147

          TOTAL FOR CYCLE                      MEAN:     40.500      1092.66                  1595.42
                                           STD DEV:     10.295        74.45                    64.46

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     36.830
                                           STD DEV:      6.912

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     25.276
                                           STD DEV:      5.431

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:     0.223
                                           STD DEV:      0.081


 MODE                 EMISSION     FUEL       TIME IN      HC          FUEL       LB HC /     ENERGY      LB HC /
                        RATE        RATE       MODE       MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.       LBS.         LBS.

TAXI-IDLE   MEAN     108.904     886.948      19.00      34.486       280.87     121.960      277.08     0.12388
            STD DEV   29.622      57.350      0.0         9.380        18.16      25.512       11.20     0.02885

TAKEOFF     MEAN       0.554   10462.508       0.70       0.006       122.06       0.056      204.17     0.00003
            STD DEV    0.784     682.911      0.0         0.009         7.97       0.079        8.25     0.00005

CLIMBOUT    MEAN       0.773    8650.008       2.20       0.028       317.17       0.093      545.42     0.00005
            STD DEV    1.093     520.461      0.0         0.040        19.08       0.132       22.04     0.00008

APPROACH    MEAN      16.436    4036.367       4.00       1.096       269.09       4.056      466.67     0.00234
            STD DEV    2.921     338.231      0.0         0.195        22.55       0.384       18.86     0.00032

TAXI-IDLE   MEAN     108.904     886.948       7.00      12.705       103.48     121.960      102.08     0.12388
            STD DEV   29.622      57.350      0.0         3.456         6.69      25.512        4.12     0.02885

          TOTAL FOR CYCLE                      MEAN:     48.322      1092.66                  1595.42
                                           STD DEV:     12.982        74.45                    64.46

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     43.921
                                           STD DEV:      8.888

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     30.148
                                           STD DEV:      6.919

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:     0.380
                                           STD DEV:      0.538


 MODE                 EMISSION     FUEL       TIME IN      NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                        RATE        RATE       MODE       MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR       MIN.       LBS.         LBS.

TAXI-IDLE   MEAN       1.855     886.948      19.00       0.587       280.87       2.088      277.08     0.00212
            STD DEV    0.210      57.350      0.0         0.067        18.16       0.102       11.20     0.00015

TAKEOFF     MEAN     154.304   10462.508       0.70       1.800       122.06      14.721      204.17     0.00880
            STD DEV   18.798     682.911      0.0         0.219         7.97       0.836        8.25     0.00072

CLIMBOUT    MEAN     106.259    8650.008       2.20       3.896       317.17      12.278      545.42     0.00714
            STD DEV    8.276     520.461      0.0         0.303        19.08       0.219       22.04     0.00027

APPROACH    MEAN      26.319    4036.367       4.00       1.755       269.09       6.564      466.67     0.00377
            STD DEV    1.977     338.231      0.0         0.132        22.55       1.040       18.86     0.00043

TAXI-IDLE   MEAN       1.855     886.948       7.00       0.216       103.48       2.088      102.08     0.00212
            STD DEV    0.210      57.350      0.0         0.025         6.69       0.102        4.12     0.00015

          TOTAL FOR CYCLE                      MEAN:      8.255      1092.66                  1595.42
                                           STD DEV:      0.482        74.45                    64.46

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:      7.557
                                           STD DEV:      0.074

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:      5.172
                                           STD DEV:      0.093

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:   102.700
                                           STD DEV:      8.382
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MODEL  JT4A  SWRI            SAMPLE NUMBER =   8.


MODE                EMISSION    FUEL      TIME IN     CO        FUEL      LB CO /     ENERGY     LB CO /
                      RATE      RATE       MODE      MASS       MASS    1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR      MIN.      LBS.       LBS.

TAXI-IDLE  MEAN     62.787    1388.763    19.00     19.882     439.78     45.231     277.08     0.07176
           STD DEV  17.688     103.796     0.0       5.601      32.86     11.907       0.0      0.02021

TAKEOFF    MEAN     18.823   15511.203     0.70      0.220     180.96      1.214     204.17     0.00108
           STD DEV   3.994     427.062     0.0       0.047       4.98      0.258       0.0      0.00023

CLIMBOUT   MEAN     18.277   13066.484     2.20      0.670     479.10      1.399     545.42     0.00123
           STD DEV   3.129     240.685     0.0       0.115       8.78      0.235       0.0      0.00021

APPROACH   MEAN     26.326    5993.734     4.00      1.755     399.58      4.412     466.67     0.00376
           STD DEV   9.529     324.933     0.0       0.635      21.66      1.671       0.0      0.00136

TAXI-IDLE  MEAN     62.787    1388.763     7.00      7.325     162.02     45.231     102.08     0.07176
           STD DEV  17.688     103.796     0.0       2.064      12.11     11.907       0.16     0.02021

           TOTAL FOR CYCLE                    MEAN:  29.852    1661.45                1595.41
                                          STD DEV:   8.042      47.30                   1.51

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:  17.971
                                          STD DEV:   4.802

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:  18.711
                                          STD DEV:   5.041

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   1.255
                                          STD DEV:   0.266


MODE                EMISSION    FUEL      TIME IN     HC        FUEL      LB HC /     ENERGY     LB HC /
                      RATE      RATE       MODE      MASS       MASS    1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR      MIN.      LBS.       LBS.

TAXI-IDLE  MEAN     64.828    1388.763    19.00     20.529     439.78     46.766     277.08     0.07409
           STD DEV  12.819     103.796     0.0       4.059      32.86      8.940       0.0      0.01465

TAKEOFF    MEAN      0.674   15511.203     0.70      0.008     180.96      0.043     204.17     0.00004
           STD DEV   0.934     427.062     0.0       0.011       4.98      0.060       0.0      0.00005

CLIMBOUT   MEAN      1.274   13066.484     2.20      0.047     479.10      0.096     545.42     0.00009
           STD DEV   2.120     240.685     0.0       0.078       8.78      0.160       0.0      0.00014

APPROACH   MEAN      3.834    5993.734     4.00      0.256     399.58      0.646     466.67     0.00055
           STD DEV   2.383     324.933     0.0       0.159      21.66      0.413       0.0      0.00034

TAXI-IDLE  MEAN     64.828    1388.763     7.00      7.563     162.02     46.766     102.08     0.07409
           STD DEV  12.819     103.796     0.0       1.496      12.11      8.946       0.16     0.01465

           TOTAL FOR CYCLE                    MEAN:  28.402    1661.45                1595.41
                                          STD DEV:   5.487      47.30                   1.51

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:  17.071
                                          STD DEV:   3.091

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:  17.802
                                          STD DEV:   3.439

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.449
                                          STD DEV:   0.623


MODE                EMISSION    FUEL      TIME IN     NOX       FUEL      LB NOX/     ENERGY     LB NOX/
                      RATE      RATE       MODE      MASS       MASS    1K LB FUEL   # TH-HR    # TH-HR
                     LB/HR      LB/HR      MIN.      LBS.       LBS.

TAXI-IDLE  MEAN      2.708    1388.763    19.00      0.857     439.78      1.941     277.08     0.00309
           STD DEV   0.629     103.796     0.0       0.199      32.86      0.374       0.0      0.00072

TAKEOFF    MEAN    236.335   15511.203     0.70      2.757     180.96     15.224     204.17     0.01350
           STD DEV  28.973     427.062     0.0       0.338       4.98      1.714       0.0      0.00166

CLIMBOUT   MEAN    155.238   13066.484     2.20      5.694     479.10     11.881     545.42     0.01044
           STD DEV   9.813     240.685     0.0       0.360       8.78      0.641       0.0      0.00066

APPROACH   MEAN     35.859    5993.734     4.00      2.391     399.58      5.976     466.67     0.00512
           STD DEV   4.203     324.933     0.0       0.280      21.66      0.526       0.0      0.00060

TAXI-IDLE  MEAN      2.708    1388.763     7.00      0.316     162.02      1.941     102.08     0.00309
           STD DEV   0.629     103.796     0.0       0.073      12.11      0.374       0.16     0.00072

           TOTAL FOR CYCLE                    MEAN:  12.015    1661.45                1595.41
                                          STD DEV:   0.803      47.30                   1.51

           LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:   7.231
                                          STD DEV:   0.419

           LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:   7.531
                                          STD DEV:   0.503

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 157.557
                                          STD DEV:  19.329
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MODEL  JT8D U-S SWRI NEW     SAMPLE NUMBER =  10.


MODE               EMISSION     FUEL       TIME IN       CO          FUEL       LB CO /     ENERGY      LB CO /
                     RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                    LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN    38.338     861.382     19.00      12.141       272.77      44.727      275.50      0.04407
          STD DEV   12.959     109.844      0.0        4.104        34.78      15.716        0.0       0.01490

TAKEOFF     MEAN     5.781    8672.137      0.70       0.067       101.17       0.667      169.17      0.00040
          STD DEV    2.057     151.132      0.0        0.024         1.76       0.241        0.14      0.00014

CLIMBOUT    MEAN     5.818    7215.180      2.20       0.213       264.56       0.808      451.92      0.00047
          STD DEV    2.292     116.726      0.0        0.084         4.29       0.322        0.33      0.00019

APPROACH    MEAN    13.516    3667.403      4.00       0.901       244.49       3.735      386.67      0.00233
          STD DEV    2.225     512.661      0.0        0.148        34.18       0.737        0.0       0.00038

TAXI-IDLE   MEAN    38.338     861.382      7.00       4.473       100.49      44.727      101.50      0.04407
          STD DEV   12.959     109.844      0.0        1.512        12.81      15.716        0.12      0.01490

         TOTAL FOR CYCLE                     MEAN:    17.795       983.49                 1384.75
                                         STD DEV:      5.714        56.29                    2.31

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:    18.113
                                         STD DEV:      5.887

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:    12.851
                                         STD DEV:      4.126

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  0.465
                                         STD DEV:      0.166


MODE               EMISSION     FUEL       TIME IN       HC          FUEL       LB HC /     ENERGY      LB HC /
                     RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                    LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     8.143     861.382     19.00       2.579       272.77       9.616      275.50      0.00936
          STD DEV    2.907     109.844      0.0        0.921        34.78       3.908        0.0       0.00334

TAKEOFF     MEAN     0.597    8672.137      0.70       0.007       101.17       0.069      169.17      0.00004
          STD DEV    1.098     151.132      0.0        0.013         1.76       0.127        0.14      0.00008

CLIMBOUT    MEAN     0.555    7215.180      2.20       0.020       264.56       0.076      451.92      0.00005
          STD DEV    0.968     116.726      0.0        0.036         4.29       0.129        0.33      0.00008

APPROACH    MEAN     1.252    3667.403      4.00       0.083       244.49       0.323      386.67      0.00022
          STD DEV    1.052     512.661      0.0        0.070        34.18       0.206        0.0       0.00018

TAXI-IDLE   MEAN     8.143     861.382      7.00       0.950       100.49       9.616      101.50      0.00936
          STD DEV    2.907     109.844      0.0        0.339        12.81       3.908        0.12      0.00334

         TOTAL FOR CYCLE                     MEAN:     3.639       983.49                 1384.75
                                         STD DEV:      1.204        56.29                    2.31

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:     3.730
                                         STD DEV:      1.342

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:     2.628
                                         STD DEV:      0.869

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  0.480
                                         STD DEV:      0.883


MODE               EMISSION     FUEL       TIME IN      NOX          FUEL       LB NOX/     ENERGY      LB NOX/
                     RATE       RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                    LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN     1.953     861.382     19.00       0.618       272.77       2.291      275.50      0.00224
          STD DEV    0.662     109.844      0.0        0.210        34.78       0.863        0.0       0.00076

TAKEOFF     MEAN   138.979    8672.137      0.70       1.621       101.17      16.046      169.17      0.00958
          STD DEV   35.009     151.132      0.0        0.408         1.76       4.158        0.14      0.00241

CLIMBOUT    MEAN    90.292    7215.180      2.20       3.311       264.56      12.520      451.92      0.00733
          STD DEV   22.103     116.726      0.0        0.810         4.29       3.102        0.33      0.00179

APPROACH    MEAN    20.709    3667.403      4.00       1.381       244.49       5.671      386.67      0.00357
          STD DEV    6.780     512.661      0.0        0.452        34.18       1.888        0.0       0.00117

TAXI-IDLE   MEAN     1.953     861.382      7.00       0.228       100.49       2.291      101.50      0.00224
          STD DEV    0.662     109.844      0.0        0.077        12.81       0.863        0.12      0.00076

         TOTAL FOR CYCLE                     MEAN:     7.159       983.49                 1384.75
                                         STD DEV:      1.822        56.29                    2.31

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:     7.323
                                         STD DEV:      2.104

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:     5.170
                                         STD DEV:      1.316

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 111.822
                                         STD DEV:     28.168
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MODEL  JT8D U-S SWRI OLD     SAMPLE NUMBER =   8.


 MODE                 EMISSION     FUEL        TIME IN       CO          FUEL       LB CO /     ENERGY      LB CO /
                        RATE       RATE         MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN      36.202      852.010      19.00      11.464       269.80       42.520      275.50     0.04161
            STD DEV   10.793      128.177      0.0         3.418        40.59       10.776        0.0      0.01241

TAKEOFF     MEAN       5.413     8684.359       0.70       0.063       101.32        0.624      169.17     0.00037
            STD DEV    2.040      279.428      0.0         0.024         3.26        0.236        0.13     0.00014

CLIMBOUT    MEAN       6.685     7116.414       2.20       0.245       260.94        0.941      451.92     0.00054
            STD DEV    1.342      195.959      0.0         0.049         7.18        0.195        0.0      0.00011

APPROACH    MEAN      10.015     3453.897       4.00       0.668       230.26        3.028      386.67     0.00173
            STD DEV    6.712      360.942      0.0         0.447        24.06        2.085        0.0      0.00116

TAXI-IDLE   MEAN      36.202      852.010       7.00       4.224        99.40       42.520      101.50     0.04161
            STD DEV   10.793      128.177      0.0         1.259        14.95       10.776        0.13     0.01241

           TOTAL FOR CYCLE                      MEAN:     16.663       961.72                  1384.75
                                            STD DEV:       4.603        82.38                     2.30

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:    17.292
                                            STD DEV:       4.290

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:    12.034
                                            STD DEV:       3.324

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:     0.436
                                            STD DEV:       0.164


 MODE                 EMISSION     FUEL        TIME IN       HC          FUEL       LB HC /     ENERGY      LB HC /
                        RATE       RATE         MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN       9.519      852.010      19.00       3.014       269.80       10.775      275.50     0.01094
            STD DEV    8.266      128.177      0.0         2.618        40.59        7.794        0.0      0.00950

TAKEOFF     MEAN       0.112     8684.359       0.70       0.001       101.32        0.013      169.17     0.00001
            STD DEV    0.116      279.428      0.0         0.001         3.26        0.014        0.13     0.00001

CLIMBOUT    MEAN       0.198     7116.414       2.20       0.007       260.94        0.028      451.92     0.00002
            STD DEV    0.168      195.959      0.0         0.006         7.18        0.024        0.0      0.00001

APPROACH    MEAN       0.348     3453.897       4.00       0.023       230.26        0.099      386.67     0.00006
            STD DEV    0.285      360.942      0.0         0.019        24.06        0.079        0.0      0.00005

TAXI-IDLE   MEAN       9.519      852.010       7.00       1.111        99.40       10.775      101.50     0.01094
            STD DEV    8.266      128.177      0.0         0.964        14.95        7.794        0.13     0.00950

           TOTAL FOR CYCLE                      MEAN:      4.157       961.72                  1384.75
                                            STD DEV:       3.594        82.38                     2.30

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     4.222
                                            STD DEV:       3.298

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     3.002
                                            STD DEV:       2.595

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:     0.090
                                            STD DEV:       0.094


 MODE                 EMISSION     FUEL        TIME IN       NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                        RATE       RATE         MODE        MASS         MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN       1.702      852.010      19.00       0.539       269.80        1.990      275.50     0.00196
            STD DEV    0.511      128.177      0.0         0.162        40.59        0.485        0.0      0.00059

TAKEOFF     MEAN     126.191     8684.359       0.70       1.472       101.32       14.467      169.17     0.00870
            STD DEV   32.557      279.428      0.0         0.380         3.26        3.424        0.13     0.00225

CLIMBOUT    MEAN      82.824     7116.414       2.20       3.037       260.94       11.599      451.92     0.00672
            STD DEV   16.055      195.959      0.0         0.589         7.18        1.976        0.0      0.00130

APPROACH    MEAN      19.658     3453.897       4.00       1.311       230.26        5.652      386.67     0.00339
            STD DEV    4.757      360.942      0.0         0.317        24.06        0.972        0.0      0.00082

TAXI-IDLE   MEAN       1.702      852.010       7.00       0.199        99.40        1.990      101.50     0.00196
            STD DEV    0.511      128.177      0.0         0.060        14.95        0.485        0.13     0.00059

           TOTAL FOR CYCLE                      MEAN:      6.557       961.72                  1384.75
                                            STD DEV:       1.456        82.38                     2.30

           LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     6.766
                                            STD DEV:       1.031

           LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     4.735
                                            STD DEV:       1.051

           LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   101.533
                                            STD DEV:      26.195
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MODEL  JT8D U-S SWRT          SAMPLE NUMBER =  18.


MODE                 EMISSION     FUEL       TIME IN       CO          FUEL       LB CO /      ENERGY      LB CO /
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN      37.389     857.216      19.00      11.840       271.45      43.746      275.50      0.04298
            STD DEV   11.750     114.788       0.0        3.721        36.35      13.411        0.54      0.01351

TAKEOFF     MEAN       5.617    8677.555       0.70       0.066       101.24       0.648      169.17      0.00039
            STD DEV    1.997     210.983       0.0        0.023         2.45       0.232        0.11      0.00014

CLIMBOUT    MEAN       6.204    7171.270       2.20       0.227       262.95       0.867      451.92      0.00050
            STD DEV    1.928     160.470       0.0        0.071         5.88       0.274        0.94      0.00016

APPROACH    MEAN      11.960    3572.512       4.00       0.797       238.17       3.420      386.67      0.00206
            STD DEV    4.937     452.440       0.0        0.329        30.16       1.486        0.59      0.00085

TAXI-IDLE   MEAN      37.389     857.216       7.00       4.362       100.01      43.746      101.50      0.04298
            STD DEV   11.750     114.788       0.0        1.371        13.39      13.411        0.06      0.01351

          TOTAL FOR CYCLE                      MEAN:     17.292       973.81                  1384.75
                                           STD DEV:       5.133        67.79                     1.37

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     17.748
                                           STD DEV:       5.109

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     12.488
                                           STD DEV:       3.707

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.452
                                           STD DEV:       0.161


MODE                 EMISSION     FUEL       TIME IN       HC          FUEL       LB HC /      ENERGY      LB HC /
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       8.755     857.216      19.00       2.772       271.45      10.131      275.50      0.01006
            STD DEV    5.754     114.788       0.0        1.822        36.35       5.784        0.54      0.00661

TAKEOFF     MEAN       0.391    8677.555       0.70       0.004       101.24       0.044      169.17      0.00003
            STD DEV    0.840     210.983       0.0        0.010         2.45       0.097        0.11      0.00006

CLIMBOUT    MEAN       0.396    7171.270       2.20       0.015       262.95       0.055      451.92      0.00003
            STD DEV    0.736     160.470       0.0        0.027         5.88       0.098        0.94      0.00006

APPROACH    MEAN       0.850    3572.512       4.00       0.057       238.17       0.224      386.67      0.00015
            STD DEV    0.913     452.440       0.0        0.061        30.16       0.195        0.59      0.00016

TAXI-IDLE   MEAN       8.755     857.216       7.00       1.021       100.01      10.131      101.50      0.01006
            STD DEV    5.754     114.788       0.0        0.671        13.39       5.784        0.06      0.00661

          TOTAL FOR CYCLE                      MEAN:      3.869       973.81                  1384.75
                                           STD DEV:       2.481        67.79                     1.37

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:      3.948
                                           STD DEV:       2.344

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:      2.794
                                           STD DEV:       1.792

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:    0.307
                                           STD DEV:       0.676


MODE                 EMISSION     FUEL       TIME IN       NOX         FUEL       LB NOX/      ENERGY      LB NOX/
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL    # TH-HR     # TH-HR
                      LB/HR      LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       1.841     857.216      19.00       0.583       271.45       2.157      275.50      0.00212
            STD DEV    0.597     114.788       0.0        0.189        36.35       0.717        0.54      0.00069

TAKEOFF     MEAN     133.295    8677.555       0.70       1.555       101.24      15.344      169.17      0.00919
            STD DEV   33.587     210.983       0.0        0.392         2.45       3.825        0.11      0.00232

CLIMBOUT    MEAN      86.972    7171.270       2.20       3.189       262.95      12.111      451.92      0.00706
            STD DEV   19.477     160.470       0.0        0.714         5.88       2.631        0.94      0.00158

APPROACH    MEAN      20.242    3572.512       4.00       1.349       238.17       5.663      386.67      0.00349
            STD DEV    5.826     452.440       0.0        0.388        30.16       1.509        0.59      0.00100

TAXI-IDLE   MEAN       1.841     857.216       7.00       0.215       100.01       2.157      101.50      0.00212
            STD DEV    0.597     114.789       0.0        0.070        13.39       0.717        0.06      0.00069

          TOTAL FOR CYCLE                      MEAN:      6.891       973.81                  1384.75
                                           STD DEV:       1.651        67.79                     1.37

          LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:      7.076
                                           STD DEV:       1.692

          LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:      4.977
                                           STD DEV:       1.192

          LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:  107.249
                                           STD DEV:      27.024
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MODEL  JT8D D-S  P&W          SAMPLE NUMBER =   8.

MODE                   EMISSION      FUEL        TIME IN       CO          FUEL        LB CO /      ENERGY      LB CO /
                         RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN        34.128      967.359      19.00       10.807       306.33       35.317       276.69      0.03906
            STD DEV      4.097       36.483       0.0         1.298        11.55        4.477         3.35      0.00470

TAKEOFF     MEAN         2.967     8693.578       0.70        0.035       101.42        0.342       169.90      0.00020
            STD DEV      1.456      162.382       0.0         0.017         1.90        0.169         2.07      0.00010

CLIMBOUT    MEAN         4.976     7311.195       2.20        0.182       268.08        0.681       453.86      0.00040
            STD DEV      1.343      160.684       0.0         0.049         5.89        0.187         5.50      0.00011

APPROACH    MEAN        17.131     3320.138       4.00        1.142       221.34        5.167       388.33      0.00294
            STD DEV      3.770       83.714       0.0         0.251         5.58        1.171         4.71      0.00065

TAXI-IDLE   MEAN        34.128      967.359       7.00        3.982       112.86       35.317       101.94      0.03906
            STD DEV      4.097       36.483       0.0         0.478         4.26        4.477         1.25      0.00470

         TOTAL FOR CYCLE                           MEAN:     16.148      1010.03                   1390.72
                                               STD DEV:       2.017        23.37                     17.04

         LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:     15.996
                                               STD DEV:       2.070

         LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:     11.612
                                               STD DEV:       1.457

         LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN:      0.238
                                               STD DEV:       0.118


MODE                   EMISSION      FUEL        TIME IN       HC          FUEL        LB HC /      ENERGY      LB HC /
                         RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN         6.564      967.359      19.00        2.079       306.33        6.767       276.69      0.00751
            STD DEV      1.949       36.483       0.0         0.617        11.55        2.004         3.35      0.00223

TAKEOFF     MEAN         0.346     8693.578       0.70        0.004       101.42        0.040       169.90      0.00002
            STD DEV      0.223      162.382       0.0         0.003         1.90        0.025         2.07      0.00002

CLIMBOUT    MEAN         0.468     7311.195       2.20        0.017       268.08        0.064       453.86      0.00004
            STD DEV      0.252      160.684       0.0         0.009         5.89        0.034         5.50      0.00002

APPROACH    MEAN         1.185     3320.138       4.00        0.079       221.34        0.357       388.33      0.00020
            STD DEV      0.214       83.714       0.0         0.014         5.58        0.067         4.71      0.00004

TAXI-IDLE   MEAN         6.564      967.359       7.00        0.766       112.86        6.767       101.94      0.00751
            STD DEV      1.949       36.483       0.0         0.227         4.26        2.004         1.25      0.00223

         TOTAL FOR CYCLE                           MEAN:      2.945      1010.03                   1390.72
                                               STD DEV:       0.841        23.37                     17.04

         LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:      2.913
                                               STD DEV:       0.834

         LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:      2.117
                                               STD DEV:       0.606

         LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN:      0.279
                                               STD DEV:       0.179


MODE                   EMISSION      FUEL        TIME IN       NOX         FUEL        LB NOX/      ENERGY      LB NOX/
                         RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR        LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN         3.012      967.359      19.00        0.954       306.33        3.102       276.69      0.00345
            STD DEV      0.807       36.483       0.0         0.256        11.55        0.781         3.35      0.00092

TAKEOFF     MEAN       207.712     8693.578       0.70        2.423       101.42       23.880       169.90      0.01426
            STD DEV     21.779      162.382       0.0         0.254         1.90        2.293         2.07      0.00139

CLIMBOUT    MEAN       139.078     7311.195       2.20        5.100       268.08       19.005       453.86      0.01123
            STD DEV     12.631      160.684       0.0         0.463         5.89        1.397         5.50      0.00090

APPROACH    MEAN        31.184     3320.138       4.00        2.079       221.34        9.388       388.33      0.00535
            STD DEV      2.620       83.714       0.0         0.175         5.58        0.691         4.71      0.00042

TAXI-IDLE   MEAN         3.012      967.359       7.00        0.351       112.86        3.102       101.94      0.00345
            STD DEV      0.807       36.483       0.0         0.094         4.26        0.781         1.25      0.00092

         TOTAL FOR CYCLE                           MEAN:     10.907      1010.03                   1390.72
                                               STD DEV:       1.030        23.37                     17.04

         LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:     10.787
                                               STD DEV:       0.820

         LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:      7.838
                                               STD DEV:       0.675

         LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN:    166.314
                                               STD DEV:      16.168
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MODEL  JT8D D-S BUR. MINES   SAMPLE NUMBER =  10.


MODE               EMISSION      FUEL        TIME IN        CO           FUEL       LB CO /     ENERGY      LB CO /
                     RATE        RATE         MODE         MASS          MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR        MIN.         LBS.          LBS.

TAXI-IDLE   MEAN     26.854     930.623      19.00        8.504        294.70       28.825      270.75     0.03140
            STD DEV   5.173      45.220       0.0         1.638         14.32        5.141        5.00     0.00602

TAKEOFF     MEAN      7.977    8699.055       0.70        0.093        101.49        0.915      166.25     0.00056
            STD DEV   2.044     245.912       0.0         0.024          2.87        0.227        3.08     0.00014

CLIMBOUT    MEAN      8.900    7299.836       2.20        0.326        267.66        1.217      444.12     0.00073
            STD DEV   1.398     174.946       0.0         0.051          6.41        0.175        8.21     0.00011

APPROACH    MEAN     17.268    3375.182       4.00        1.151        225.01        5.113      380.00     0.00303
            STD DEV   2.310     142.461       0.0         0.154          9.50        0.613        7.01     0.00039

TAXI-IDLE   MEAN     26.854     930.623       7.00        3.133        108.57       28.825       99.75     0.03140
            STD DEV   5.173      45.220       0.0         0.604          5.28        5.141        1.85     0.00602

           TOTAL FOR CYCLE                      MEAN:    13.207        997.43                  1360.87
                                            STD DEV:      2.291         28.49                    25.26

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    13.240
                                            STD DEV:      2.247

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     9.703
                                            STD DEV:      1.666

           LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    0.653
                                            STD DEV:      0.168


MODE               EMISSION      FUEL        TIME IN        HC           FUEL       LB HC /     ENERGY      LB HC /
                     RATE        RATE         MODE         MASS          MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR        MIN.         LBS.          LBS.

TAXI-IDLE   MEAN      7.321     930.623      19.00        2.318        294.70        7.863      270.75     0.00854
            STD DEV   2.540      45.220       0.0         0.804         14.32        2.707        5.00     0.00288

TAKEOFF     MEAN      0.826    8699.055       0.70        0.010        101.49        0.095      166.25     0.00006
            STD DEV   1.476     245.912       0.0         0.017          2.87        0.168        3.08     0.00010

CLIMBOUT    MEAN      1.184    7299.836       2.20        0.043        267.66        0.163      444.12     0.00010
            STD DEV   1.349     174.946       0.0         0.049          6.41        0.185        8.21     0.00011

APPROACH    MEAN      2.394    3375.182       4.00        0.160        225.01        0.713      380.00     0.00042
            STD DEV   0.935     142.461       0.0         0.062          9.50        0.284        7.01     0.00016

TAXI-IDLE   MEAN      7.321     930.623       7.00        0.854        108.57        7.863       99.75     0.00854
            STD DEV   2.540      45.220       0.0         0.296          5.28        2.707        1.85     0.00288

           TOTAL FOR CYCLE                      MEAN:     3.385        997.43                  1360.87
                                            STD DEV:      1.180         28.49                    25.26

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:     3.395
                                            STD DEV:      1.178

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     2.482
                                            STD DEV:      0.841

           LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:    0.672
                                            STD DEV:      1.191


MODE               EMISSION      FUEL        TIME IN       NOX           FUEL       LB NOX/     ENERGY      LB NOX/
                     RATE        RATE         MODE         MASS          MASS     1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR       LB/HR        MIN.         LBS.          LBS.

TAXI-IDLE   MEAN      3.258     930.623      19.00        1.032        294.70        3.476      270.75     0.00381
            STD DEV   1.337      45.220       0.0         0.424         14.32        1.315        5.00     0.00153

TAKEOFF     MEAN    188.047    8699.055       0.70        2.194        101.49       21.604      166.25     0.01320
            STD DEV  30.229     245.912       0.0         0.353          2.87        3.269        3.08     0.00214

CLIMBOUT    MEAN    124.179    7299.836       2.20        4.553        267.66       17.015      444.12     0.01026
            STD DEV  17.249     174.946       0.0         0.632          6.41        2.327        8.21     0.00148

APPROACH    MEAN     31.263    3375.182       4.00        2.084        225.01        9.250      380.00     0.00549
            STD DEV   5.180     142.461       0.0         0.345          9.50        1.382        7.01     0.00095

TAXI-IDLE   MEAN      3.258     930.623       7.00        0.380        108.57        3.476       99.75     0.00381
            STD DEV   1.337      45.220       0.0         0.156          5.28        1.315        1.85     0.00153

           TOTAL FOR CYCLE                      MEAN:    10.243        997.43                  1360.87
                                            STD DEV:      1.497         28.49                    25.26

           LBS POLLUTANT/1K LB FUEL/CYCLE       MEAN:    10.262
                                            STD DEV:      1.408

           LBS POLLUTANT/1K LB TH-HR/CYCLE      MEAN:     7.531
                                            STD DEV:      1.116

           LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:  154.038
                                            STD DEV:     24.979
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MODEL  JT8D D-R BUR. MINES   SAMPLE NUMBER =   5.


MODE                 EMISSION     FUEL       TIME IN       CO          FUEL       LB CO /     ENERGY      LB CO /
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE  MEAN       42.556     958.994     19.00      13.476       303.68      44.262      266.00     0.05066
           STD DEV    12.546     131.973     0.0         3.973        41.79      10.278        0.0      0.01494

TAKEOFF    MEAN       13.720    8485.988      0.70       0.160        99.00       1.61[illegible]      163.33     0.00098
           STD DEV     7.158     140.171     0.0         0.084         1.64       0.826        0.0      0.00051

CLIMBOUT   MEAN       14.714    7179.410      2.20       0.540       263.24       2.050      436.33     0.00124
           STD DEV     5.605     137.942     0.0         0.206         5.06       0.778        0.0      0.00047

APPROACH   MEAN       30.035    3506.267      4.00       2.002       233.75       8.686      373.33     0.00536
           STD DEV     7.562     234.034     0.0         0.504        15.60       2.606        0.0      0.00135

TAXI-IDLE  MEAN       42.556     958.994      7.00       4.965       111.88      44.262       98.00     0.05066
           STD DEV    12.546     131.973     0.0         1.464        15.40      10.278        0.13     0.01494

          TOTAL FOR CYCLE                           MEAN:  21.143     1011.56                 1337.00
                                                STD DEV:    6.101       68.82                    1.73

          LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:  20.870
                                                STD DEV:    5.545

          LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:  15.814
                                                STD DEV:    4.563

          LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN:   1.143
                                                STD DEV:    0.596


MODE                 EMISSION     FUEL       TIME IN       HC          FUEL       LB HC /     ENERGY      LB HC /
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE  MEAN       13.250     958.994     19.00       4.196       303.68      13.682      266.00     0.01577
           STD DEV     5.967     131.973     0.0         1.890        41.79       5.036        0.0      0.00710

TAKEOFF    MEAN        0.264    8485.988      0.70       0.003        99.00       0.031      163.33     0.00002
           STD DEV     0.211     140.171     0.0         0.002         1.64       0.025        0.0      0.00002

CLIMBOUT   MEAN        0.857    7179.410      2.20       0.031       263.24       0.120      436.33     0.00007
           STD DEV     1.218     137.942     0.0         0.045         5.06       0.170        0.0      0.00010

APPROACH   MEAN        4.028    3506.267      4.00       0.269       233.75       1.172      373.33     0.00072
           STD DEV     2.253     234.034     0.0         0.150        15.60       0.692        0.0      0.00040

TAXI-IDLE  MEAN       13.250     958.994      7.00       1.546       111.88      13.682       98.00     0.01577
           STD DEV     5.967     131.973     0.0         0.696        15.40       5.036        0.13     0.00710

          TOTAL FOR CYCLE                           MEAN:   6.045     1011.56                 1337.00
                                                STD DEV:    2.655       68.82                    1.73

          LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:   5.950
                                                STD DEV:    2.421

          LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:   4.521
                                                STD DEV:    1.986

          LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN:   0.220
                                                STD DEV:    0.176


MODE                 EMISSION     FUEL       TIME IN       NOX         FUEL       LB NOX/     ENERGY      LB NOX/
                       RATE       RATE        MODE        MASS         MASS     1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.        LBS.         LBS.

TAXI-IDLE  MEAN        3.358     958.994     19.00       1.063       303.68       3.433      266.00     0.00400
           STD DEV     1.447     131.973     0.0         0.458        41.79       1.102        0.0      0.00172

TAKEOFF    MEAN      150.216    8485.989      0.70       1.753        99.00      17.702      163.33     0.01073
           STD DEV    26.483     140.171     0.0         0.309         1.64       3.074        0.0      0.00189

CLIMBOUT   MEAN       97.447    7179.410      2.20       3.573       263.24      13.563      436.33     0.00819
           STD DEV    22.748     137.942     0.0         0.836         5.06       3.069        0.0      0.00191

APPROACH   MEAN       27.863    3506.267      4.00       1.858       233.75       7.965      373.33     0.00498
           STD DEV     3.721     234.034     0.0         0.248        15.60       1.121        0.0      0.00066

TAXI-IDLE  MEAN        3.358     958.994      7.00       0.392       111.88       3.433       98.00     0.00400
           STD DEV     1.447     131.973     0.0         0.169        15.40       1.102        0.13     0.00172

          TOTAL FOR CYCLE                           MEAN:   8.638     1011.56                 1337.00
                                                STD DEV:    1.302       68.82                    1.73

          LBS POLLUTANT/1K LB FUEL/CYCLE            MEAN:   8.537
                                                STD DEV:    1.085

          LBS POLLUTANT/1K LB TH-HR/CYCLE           MEAN:   6.461
                                                STD DEV:    0.974

          LBS POLLUTANT/1000K LB TH-HR AT T.O.      MEAN: 125.180
                                                STD DEV:   22.069
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MODEL  JT8D D-S UNITED        SAMPLE NUMBER =   4.


MODE                EMISSION     FUEL      TIME IN       CO        FUEL       LB CO /     ENERGY      LB CO /
                      RATE       RATE       MODE        MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.       LBS.


TAXI-IDLE   MEAN    21.448     955.042     19.00       6.792     302.43       23.532      266.00     0.02553
            STD DEV 14.820      90.830      0.0        4.693      28.76       16.629        0.0      0.01764

TAKEOFF     MEAN    12.540    8331.246      0.70       0.146      97.20        1.504      163.33     0.00090
            STD DEV  9.266     123.935      0.0        0.108       1.44        1.115        0.0      0.00066

CLIMBOUT    MEAN    14.341    7020.453      2.20       0.526     257.42        2.043      436.33     0.00121
            STD DEV  7.687      80.730      0.0        0.282       2.96        1.097        0.0      0.00065

APPROACH    MEAN    19.787    3370.989      4.00       1.319     224.73        5.895      373.33     0.00353
            STD DEV 12.976      64.415      0.0        0.865       4.29        3.850        0.0      0.00232

TAXI-IDLE   MEAN    21.448     955.042      7.00       2.502     111.42       23.532       98.00     0.02553
            STD DEV 14.820      90.830      0.0        1.729      10.60       16.629        0.11     0.01764

        TOTAL FOR CYCLE                          MEAN:  11.285     993.20                  1337.00
                                             STD DEV:   7.547      42.13                     1.29

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:  11.594
                                             STD DEV:   7.857

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   8.441
                                             STD DEV:   5.645

        LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   1.045
                                             STD DEV:   0.772


MODE                EMISSION     FUEL      TIME IN       HC        FUEL       LB HC /     ENERGY      LB HC /
                      RATE       RATE       MODE        MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.       LBS.


TAXI-IDLE   MEAN     5.194     955.042     19.00       1.645     302.43        5.673      266.00     0.00618
            STD DEV  4.389      90.830      0.0        1.390      28.76        4.860        0.0      0.00522

TAKEOFF     MEAN     0.240    8331.246      0.70       0.003      97.20        0.029      163.33     0.00002
            STD DEV  0.285     123.935      0.0        0.003       1.44        0.034        0.0      0.00002

CLIMBOUT    MEAN     0.277    7020.453      2.20       0.010     257.42        0.039      436.33     0.00002
            STD DEV  0.254      80.730      0.0        0.009       2.96        0.036        0.0      0.00002

APPROACH    MEAN     0.949    3370.989      4.00       0.063     224.73        0.283      373.33     0.00017
            STD DEV  0.553      64.415      0.0        0.037       4.29        0.167        0.0      0.00010

TAXI-IDLE   MEAN     5.194     955.042      7.00       0.606     111.42        5.673       98.00     0.00618
            STD DEV  4.339      90.830      0.0        0.512      10.60        4.860        0.11     0.00522

        TOTAL FOR CYCLE                          MEAN:   2.327     993.20                  1337.00
                                             STD DEV:   1.926      42.13                     1.29

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   2.387
                                             STD DEV:   1.996

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   1.741
                                             STD DEV:   1.440

        LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   0.200
                                             STD DEV:   0.238


MODE                EMISSION     FUEL      TIME IN      NOX        FUEL       LB NOX/     ENERGY      LB NOX/
                      RATE       RATE       MODE        MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                     LB/HR      LB/HR       MIN.        LBS.       LBS.


TAXI-IDLE   MEAN     1.721     955.042     19.00       0.545     302.43        1.873      266.00     0.00205
            STD DEV  0.892      90.830      0.0        0.282      28.76        1.023        0.0      0.00106

TAKEOFF     MEAN   155.316    8331.246      0.70       1.812      97.20       18.641      163.33     0.01109
            STD DEV 17.169     123.935      0.0        0.200       1.44        2.046        0.0      0.00123

CLIMBOUT    MEAN   109.007    7020.453      2.20       3.997     257.42       15.528      436.33     0.00916
            STD DEV 12.127      80.730      0.0        0.445       2.96        1.731        0.0      0.00102

APPROACH    MEAN    28.441    3370.989      4.00       1.896     224.73        8.427      373.33     0.00508
            STD DEV  2.882      64.415      0.0        0.192       4.29        0.700        0.0      0.00051

TAXI-IDLE   MEAN     1.721     955.042      7.00       0.201     111.42        1.873       98.00     0.00205
            STD DEV  0.892      90.830      0.0        0.104      10.60        1.023        0.11     0.00106

        TOTAL FOR CYCLE                          MEAN:   8.451     993.20                  1337.00
                                             STD DEV:   0.533      42.13                     1.29

        LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   8.515
                                             STD DEV:   0.555

        LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   6.321
                                             STD DEV:   0.398

        LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN: 129.430
                                             STD DEV:  14.309
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MODEL  JT8D D-R UNITED        SAMPLE NUMBER =   2.


MODE                  EMISSION     FUEL      TIME IN      CO        FUEL        LB CO /     ENERGY      LB CO /
                        RATE       RATE       MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.       LBS.


TAXI-IDLE   MEAN       32.080     723.396     19.00     10.159     229.08       48.140      266.00     0.03819
            STD DEV     5.729     352.811      0.0       1.814     111.72       15.559        0.0      0.00682

TAKEOFF     MEAN       30.605    8211.008      0.70      0.357      95.80        3.751      163.33     0.00219
            STD DEV    30.128     104.690      0.0       0.351       1.22        3.717        0.09     0.00215

CLIMBOUT    MEAN       31.123    6896.359      2.20      1.141     252.87        4.531      436.33     0.00262
            STD DEV    27.426      60.531      0.0       1.006       2.22        4.017        0.0      0.00230

APPROACH    MEAN       38.048    3340.465      4.00      2.537     222.70       11.424      373.33     0.00679
            STD DEV    16.399      44.542      0.0       1.093       2.98        5.062        0.0      0.00293

TAXI-IDLE   MEAN       32.080     723.396      7.00      3.743      84.40       48.140       98.00     0.03819
            STD DEV     5.729     352.811      0.0       0.668      41.16       15.559        0.0      0.00682

         TOTAL FOR CYCLE                     MEAN:     17.936     884.83                   1337.00
                                          STD DEV:      0.035     159.30                      0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:     20.601
                                          STD DEV:      3.673

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:     13.415
                                          STD DEV:      0.031

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   2.550
                                          STD DEV:      2.511


MODE                  EMISSION     FUEL      TIME IN      HC        FUEL        LB HC /     ENERGY      LB HC /
                        RATE       RATE       MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.       LBS.


TAXI-IDLE   MEAN        5.542     723.396     19.00      1.755     229.08        6.922      266.00     0.00660
            STD DEV     4.636     352.811      0.0       1.468     111.72        3.032        0.0      0.00552

TAKEOFF     MEAN        0.444    8211.008      0.70      0.005      95.80        0.055      163.33     0.00003
            STD DEV     0.628     104.690      0.0       0.007       1.22        0.077        0.09     0.00004

CLIMBOUT    MEAN        0.754    6896.359      2.20      0.028     252.87        0.110      436.33     0.00006
            STD DEV     0.756      60.531      0.0       0.028       2.22        0.111        0.0      0.00006

APPROACH    MEAN        1.631    3340.465      4.00      0.109     222.70        0.488      373.33     0.00029
            STD DEV     0.052      44.542      0.0       0.003       2.98        0.009        0.0      0.00001

TAXI-IDLE   MEAN        5.542     723.396      7.00      0.647      84.40        6.922       98.00     0.00660
            STD DEV     4.636     352.811      0.0       0.541      41.16        3.032        0.0      0.00552

         TOTAL FOR CYCLE                     MEAN:      2.543     884.83                   1337.00
                                          STD DEV:      1.977     159.30                      0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:      2.717
                                          STD DEV:      1.745

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:      1.902
                                          STD DEV:      1.479

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:   0.370
                                          STD DEV:      0.523


MODE                  EMISSION     FUEL      TIME IN      NOX       FUEL        LB NOX/     ENERGY      LB NOX/
                        RATE       RATE       MODE       MASS       MASS      1K LB FUEL   # TH-HR     # TH-HR
                       LB/HR      LB/HR       MIN.       LBS.       LBS.


TAXI-IDLE   MEAN        1.785     723.396     19.00      0.565     229.08        2.465      266.00     0.00212
            STD DEV     0.878     352.811      0.0       0.278     111.72        0.011        0.0      0.00104

TAKEOFF     MEAN      153.912    8211.008      0.70      1.796      95.80       18.745      163.33     0.01099
            STD DEV     1.081     104.690      0.0       0.013       1.22        0.108        0.09     0.00008

CLIMBOUT    MEAN      106.887    6896.359      2.20      3.919     252.87       15.500      436.33     0.00898
            STD DEV     0.410      60.531      0.0       0.015       2.22        0.196        0.0      0.00003

APPROACH    MEAN       28.509    3340.465      4.00      1.901     222.70        8.535      373.33     0.00509
            STD DEV     0.128      44.542      0.0       0.009       2.98        0.076        0.0      0.00002

TAXI-IDLE   MEAN        1.785     723.396      7.00      0.208      84.40        2.465       98.00     0.00212
            STD DEV     0.878     352.811      0.0       0.102      41.16        0.011        0.0      0.00104

         TOTAL FOR CYCLE                     MEAN:      8.389     884.83                   1337.00
                                          STD DEV:      0.386     159.30                      0.0

         LBS POLLUTANT/1K LB FUEL/CYCLE      MEAN:      9.597
                                          STD DEV:      1.291

         LBS POLLUTANT/1K LB TH-HR/CYCLE     MEAN:      6.274
                                          STD DEV:      0.289

         LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN: 128.260
                                          STD DEV:      0.923
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MODEL  JT8D U-R SWRI          SAMPLE NUMBER =   7.

MODE                   EMISSION      FUEL       TIME IN       CO          FUEL        LB CO /    ENERGY       LB CO /
                         RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN       41.395      823.275      19.00       13.108       260.70       50.320      266.00      0.04928
            STD DEV    11.148      113.528       0.0         3.530        35.95       13.014        0.0       0.01327

TAKEOFF     MEAN        7.975     8517.727       0.70        0.093        99.37        0.934      163.33      0.00057
            STD DEV     3.354      165.892       0.0         0.039         1.94        0.388        0.0       0.00024

CLIMBOUT    MEAN       10.621     7116.582       2.20        0.389       260.94        1.493      436.33      0.00089
            STD DEV     4.385       95.555       0.0         0.161         3.51        0.617        0.0       0.00037

APPROACH    MEAN       17.920     3445.414       4.00        1.195       229.69        5.210      373.33      0.00320
            STD DEV     1.665      180.022       0.0         0.111        12.00        0.518        0.0       0.00030

TAXI-IDLE   MEAN       41.395      823.275       7.00        4.829        96.05       50.320       98.00      0.04928
            STD DEV    11.148      113.528       0.0         1.301        13.24       13.014        0.14      0.01327

          TOTAL FOR CYCLE                       MEAN:     19.615       946.76                   1337.00
                                            STD DEV:      4.967        49.19                      2.08

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:     20.657
                                            STD DEV:      4.947

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:     14.671
                                            STD DEV:      3.715

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      0.665
                                            STD DEV:      0.279


MODE                   EMISSION      FUEL       TIME IN       HC          FUEL        LB HC /    ENERGY       LB HC /
                         RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN        8.322      823.275      19.00        2.635       260.70       10.102      266.00      0.00991
            STD DEV     3.003      113.528       0.0         0.951        35.95        3.399        0.0       0.00357

TAKEOFF     MEAN        0.373     8517.727       0.70        0.004        99.37        0.043      163.33      0.00003
            STD DEV     0.563      165.892       0.0         0.007         1.94        0.066        0.0       0.00004

CLIMBOUT    MEAN        0.313     7116.582       2.20        0.011       260.94        0.044      436.33      0.00003
            STD DEV     0.459       95.555       0.0         0.017         3.51        0.065        0.0       0.00004

APPROACH    MEAN        1.179     3445.414       4.00        0.079       229.69        0.332      373.33      0.00021
            STD DEV     1.372      180.022       0.0         0.091        12.00        0.368        0.0       0.00024

TAXI-IDLE   MEAN        8.322      823.275       7.00        0.971        96.05       10.102       98.00      0.00991
            STD DEV     3.003      113.528       0.0         0.350        13.24        3.399        0.14      0.00357

          TOTAL FOR CYCLE                       MEAN:      3.701       946.76                   1337.00
                                            STD DEV:      1.276        49.19                      2.08

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      3.901
                                            STD DEV:      1.306

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      2.768
                                            STD DEV:      0.954

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:      0.311
                                            STD DEV:      0.469


MODE                   EMISSION      FUEL       TIME IN       NOX         FUEL        LB NOX/    ENERGY       LB NOX/
                         RATE        RATE        MODE        MASS         MASS      1K LB FUEL   # TH-HR      # TH-HR
                        LB/HR       LB/HR        MIN.        LBS.         LBS.

TAXI-IDLE   MEAN        1.765      823.275      19.00        0.559       260.70        2.172      266.00      0.00210
            STD DEV     0.257      113.528       0.0         0.081        35.95        0.410        0.0       0.00031

TAKEOFF     MEAN      101.636     8517.727       0.70        1.186        99.37       11.930      163.33      0.00726
            STD DEV    14.360      165.892       0.0         0.168         1.94        1.644        0.0       0.00103

CLIMBOUT    MEAN       67.746     7116.582       2.20        2.484       260.94        9.517      436.33      0.00569
            STD DEV    11.251       95.555       0.0         0.413         3.51        1.559        0.0       0.00095

APPROACH    MEAN       16.952     3445.414       4.00        1.130       229.69        4.959      373.33      0.00303
            STD DEV     2.870      180.022       0.0         0.191        12.00        1.097        0.0       0.00051

TAXI-IDLE   MEAN        1.765      823.275       7.00        0.206        96.05        2.172       98.00      0.00210
            STD DEV     0.257      113.528       0.0         0.030        13.24        0.410        0.14      0.00031

          TOTAL FOR CYCLE                       MEAN:      5.565       946.76                   1337.00
                                            STD DEV:      0.582        49.19                      2.08

          LBS POLLUTANT/1K LB FUEL/CYCLE        MEAN:      5.904
                                            STD DEV:      0.805

          LBS POLLUTANT/1K LB TH-HR/CYCLE       MEAN:      4.162
                                            STD DEV:      0.435

          LBS POLLUTANT/1000K LB TH-HR AT T.O.  MEAN:     84.697
                                            STD DEV:     11.967
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MODEL  JT9D P&W              SAMPLE NUMBER =   5.


 MODE                EMISSION      FUEL       TIME IN        CO          FUEL       LB CO /     ENERGY       LB CO /
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                      LB/HR       LB/HR        MIN.         LBS.         LBS.


TAXI-IDLE   MEAN     85.894     1607.060      19.00        27.200       508.90       53.460     1008.58      0.02697
           STD DEV    8.683      155.707       0.0          2.749        49.30        1.810        1.32      0.00273

TAKEOFF     MEAN      6.456    16627.023       0.70         0.075       193.98        0.389      530.83      0.00014
           STD DEV    4.529      824.427       0.0          0.053         9.62        0.282        0.0       0.00010

CLIMBOUT    MEAN     10.879    13828.898       2.20         0.399       507.06        0.791     1418.08      0.00028
           STD DEV    3.405      775.588       0.0          0.125        28.43        0.261        1.32      0.00009

APPROACH    MEAN     37.555     4895.531       4.00         2.504       326.37        7.788      910.00      0.00275
           STD DEV   13.344      389.702       0.0          0.890        25.98        3.220        0.0       0.00098

TAXI-IDLE   MEAN     85.894     1607.060       7.00        10.021       187.49       53.460      371.58      0.02697
           STD DEV    8.683      155.707       0.0          1.013        18.17        1.810        0.0       0.00273

           TOTAL FOR CYCLE                          MEAN:  40.199      1723.80                  4239.08
                                                STD DEV:    3.809        99.15                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:  23.301
                                                STD DEV:    1.386

           LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   9.433
                                                STD DEV:    0.899

           LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   0.166
                                                STD DEV:    0.116


 MODE                EMISSION      FUEL       TIME IN        HC          FUEL       LB HC /     ENERGY       LB HC /
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                      LB/HR       LB/HR        MIN.         LBS.         LBS.


TAXI-IDLE   MEAN     19.432     1607.060      19.00         6.154       508.90       11.958     1008.58      0.00610
           STD DEV    6.797      155.707       0.0          2.152        49.30        3.148        1.32      0.00213

TAKEOFF     MEAN      2.015    16627.023       0.70         0.024       193.98        0.123      530.83      0.00004
           STD DEV    2.271      824.427       0.0          0.026         9.62        0.138        0.0       0.00005

CLIMBOUT    MEAN      1.990    13828.898       2.20         0.073       507.06        0.145     1418.08      0.00005
           STD DEV    1.881      775.588       0.0          0.069        28.43        0.138        1.32      0.00005

APPROACH    MEAN      3.216     4895.531       4.00         0.214       326.37        0.669      910.00      0.00024
           STD DEV    0.895      389.702       0.0          0.060        25.98        0.225        0.0       0.00007

TAXI-IDLE   MEAN     19.432     1607.060       7.00         2.267       187.49       11.958      371.58      0.00610
           STD DEV    6.797      155.707       0.0          0.793        18.17        3.146        0.0       0.00213

           TOTAL FOR CYCLE                          MEAN:   8.732      1723.80                  4239.08
                                                STD DEV:    2.934        99.15                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:   5.057
                                                STD DEV:    1.579

           LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   2.060
                                                STD DEV:    0.692

           LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN:   0.517
                                                STD DEV:    0.582


 MODE                EMISSION      FUEL       TIME IN        NOX         FUEL       LB NOX/     ENERGY       LB NOX/
                       RATE        RATE        MODE         MASS         MASS     1K LB FUEL    # TH-HR      # TH-HR
                      LB/HR       LB/HR        MIN.         LBS.         LBS.


TAXI-IDLE   MEAN      6.212     1607.060      19.00         1.967       508.90        3.810     1008.58      0.00195
           STD DEV    2.636      155.707       0.0          0.835        49.30        1.363        1.32      0.00083

TAKEOFF     MEAN    671.866    16627.023       0.70         7.838       193.98       40.215      530.83      0.01477
           STD DEV  121.336      824.427       0.0          1.416         9.62        5.078        0.0       0.00267

CLIMBOUT    MEAN    424.907    13828.898       2.20        15.580       507.06       30.628     1418.08      0.01099
           STD DEV   57.977      775.588       0.0          2.126        28.43        2.426        1.32      0.00150

APPROACH    MEAN     53.965     4895.531       4.00         3.598       326.37       11.050      910.00      0.00395
           STD DEV    6.279      389.702       0.0          0.419        25.98        1.284        0.0       0.00046

TAXI-IDLE   MEAN      6.212     1607.060       7.00         0.725       187.49        3.810      371.58      0.00195
           STD DEV    2.636      155.707       0.0          0.308        18.17        1.363        0.0       0.00083

           TOTAL FOR CYCLE                          MEAN:  29.708      1723.80                  4239.08
                                                STD DEV:    3.221        99.15                     0.0

           LBS POLLUTANT/1K LB FUEL/CYCLE           MEAN:  17.201
                                                STD DEV:    1.010

           LBS POLLUTANT/1K LB TH-HR/CYCLE          MEAN:   7.008
                                                STD DEV:    0.760

           LBS POLLUTANT/1000K LB TH-HR AT T.O.     MEAN: 172.273
                                                STD DEV:   31.113
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MODEL  SPEY 511 BUR. MINES   SAMPLE NUMBER =   4.


MODE                    EMISSION      FUEL        TIME IN       CO          FUEL        LB CO /     ENERGY       LB CO /
                          RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                          LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN         60.173      661.542      19.00       19.055       209.49       89.861      144.40       0.13196
            STD DEV      19.601      110.889       0.0         6.207        35.12       20.325        0.0        0.04298

TAKEOFF     MEAN         14.218     7625.230       0.70        0.166        88.96        1.870      133.00       0.00125
            STD DEV       2.944      150.022       0.0         0.034         1.75        0.426        0.25        0.00026

CLIMBOUT    MEAN         15.251     6354.934       2.20        0.559       233.01        2.401      355.30       0.00157
            STD DEV       1.804       60.839       0.0         0.066         2.24        0.298        0.0         0.00019

APPROACH    MEAN         39.068     3051.668       4.00        2.605       203.44       12.868      304.00       0.00857
            STD DEV      10.078      123.028       0.0         0.672         8.21        3.550        0.0         0.00221

TAXI-IDLE   MEAN         60.173      661.542       7.00        7.020        77.18       89.861       53.20       0.13196
            STD DEV      19.601      110.889       0.0         2.287        12.94       20.325        0.0         0.04298

        TOTAL FOR CYCLE                        MEAN:      29.405       812.09                   989.90
                                           STD DEV:        9.054        43.96                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:      35.942
                                           STD DEV:        9.707

        LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:      29.705
                                           STD DEV:        9.147

        LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:       1.455
                                           STD DEV:        0.301


MODE                    EMISSION      FUEL        TIME IN       HC          FUEL        LB HC /     ENERGY       LB HC /
                          RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                          LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN         66.051      661.542      19.00       20.916       209.49      102.865      144.40       0.14485
            STD DEV      11.083      110.889       0.0         3.510        35.12       28.897        0.0         0.02430

TAKEOFF     MEAN          0.0       7625.230       0.70        0.0          88.96        0.0        133.00       0.0
            STD DEV       0.0        150.022       0.0         0.0           1.75        0.0          0.25       0.0

CLIMBOUT    MEAN          0.242     6354.934       2.20        0.009       233.01        0.038      355.30       0.00003
            STD DEV       0.221       60.839       0.0         0.008         2.24        0.035        0.0         0.00002

APPROACH    MEAN          4.224     3051.668       4.00        0.282       203.44        1.394      304.00       0.00093
            STD DEV       4.447      123.028       0.0         0.296         8.21        1.451        0.0         0.00098

TAXI-IDLE   MEAN         66.051      661.542       7.00        7.706        77.18      102.865       53.20       0.14485
            STD DEV      11.083      110.889       0.0         1.293        12.94       28.897        0.0         0.02430

        TOTAL FOR CYCLE                        MEAN:      28.912       812.09                   989.90
                                           STD DEV:        4.542        43.96                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:      35.776
                                           STD DEV:        6.654

        LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:      29.207
                                           STD DEV:        4.588

        LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:       0.0
                                           STD DEV:        0.0


MODE                    EMISSION      FUEL        TIME IN       NOX         FUEL        LB NOX/     ENERGY       LB NOX/
                          RATE        RATE         MODE        MASS         MASS       1K LB FUEL   # TH-HR      # TH-HR
                          LB/HR       LB/HR        MIN.        LBS.         LBS.


TAXI-IDLE   MEAN          0.849      661.542      19.00        0.269       209.49        1.271      144.40       0.00186
            STD DEV       0.381      110.889       0.0         0.121        35.12        0.501        0.0         0.00084

TAKEOFF     MEAN        153.012     7625.230       0.70        1.785        88.96       20.081      133.00       0.01342
            STD DEV       9.845      150.022       0.0         0.115         1.75        1.519        0.25        0.00086

CLIMBOUT    MEAN        114.759     6354.934       2.20        4.208       233.01       18.073      355.30       0.01184
            STD DEV      13.724       60.839       0.0         0.503         2.24        2.316        0.0         0.00142

APPROACH    MEAN         30.446     3051.668       4.00        2.030       203.44        9.939      304.00       0.00668
            STD DEV       5.197      123.028       0.0         0.346         8.21        1.331        0.0         0.00114

TAXI-IDLE   MEAN          0.849      661.542       7.00        0.099        77.18        1.271       53.20       0.00186
            STD DEV       0.381      110.889       0.0         0.044        12.94        0.501        0.0         0.00084

        TOTAL FOR CYCLE                        MEAN:       8.391       812.09                   989.90
                                           STD DEV:        0.842        43.96                     0.0

        LBS POLLUTANT/1K LB FUEL/CYCLE         MEAN:      10.392
                                           STD DEV:        1.524

        LBS POLLUTANT/1K LB TH-HR/CYCLE        MEAN:       8.476
                                           STD DEV:        0.850

        LBS POLLUTANT/1000K LB TH-HR AT T.O.   MEAN:     156.591
                                           STD DEV:       10.075
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